



हरीयाणा केंद्रीय विश्वविद्यालय
CENTRAL UNIVERSITY OF HARYANA
NAAC ACCREDITED 'A' GRADE UNIVERSITY

MINUTES

28th Meeting of the Academic Council

Date: 26/06/2019 at 02:30 P.M.

Venue: Gurugram Office, Central University of Haryana, Gurugram

The 28th meeting of the Academic Council of Central University of Haryana was held on June 26, 2019 at 02:30 P.M. in the Conference Room, University's Gurugram Office, Gurugram, Haryana.

The following members were present:

1. **Prof. R.C. Kuhad, Vice Chancellor** - Chairperson
2. Prof. K.P.S. Mahalwar
3. Prof. M.C. Garg
4. Prof. Om Prakash Arora
5. Prof. R.S. Yadav
6. Dr. P.K. Khurana
7. Prof. Sanjiv Kumar
8. Prof. Sarika Sharma
9. Prof. Nawal Kishore
10. Prof. Rajesh Kumar Malik
11. Prof. Satish Kumar
12. Prof. Neelam Sangwan
13. Dr. Parmod Kumar
14. Dr. Anand Sharma
15. Dr. Gunjan Goel
16. Dr. Vikas Garg
17. Dr. Rajesh Kumar Gupta
18. Dr. Bijender Singh
19. Dr. Vinod Kumar
20. Dr. Ajai Pal Sharma
21. Dr. Anju Beniwal
22. **Sh. Ram Dutt, Registrar** - Secretary

The following members could not attend the meeting: -

1. Dr. M.P. Poonia
2. Prof. R.P. Tandon
3. Prof. R.K. Anayath
4. Dr. (Mrs.) Shimla
5. Prof. P.C. Pattnaik
6. Dr. Avaniresh Awasthi
7. Prof. S.V.S. Choudhary
8. Prof. Vijay Kumar Kayat
9. Prof. Bir Singh
10. Prof. Deepak Pant
11. Dr. Rajesh Kumar Dubey
12. Dr. Chanchal Kumar Sharma
13. Dr. Vinay Kumar Rao
14. Prof. Ranvir Singh (Special Invitee)

At the outset, the Vice-Chancellor extended a warm welcome to all the members of the Academic Council. Brief details about the various academic, research and other activities were presented before the Council. The Council was also apprised about the various Social Outreach programmes, cultural and other NSS/YRC activities carried out in the University. The digital initiatives undertaken by the University were also brought to the notice of the Council.

After the presentation of report on Academic and other achievements made by the University, the Agenda items were taken up.

Agenda Items

R. No.	DESCRIPTION						
1.	The Minutes of the 27 th meeting of the Academic Council held on 19.02.2019, were confirmed.						
2.	The actions taken on the resolutions of the 27 th meeting of the Academic Council held on 19.02.2019, were reported, recorded and confirmed.						
ITEMS FOR CONSIDERATION							
3.	Resolved that, in pursuance of the comments of the UGC received vide MHRD letter No.F.58-6/2018-CU.III dated 12.06.2019, the following amendments to Statute-15(1) of the Statutes of the University relating to the Schools and Departments of Studies, be approved and recommended to the Executive Council for consideration: <table border="1"> <tr> <th>Amendment approved by the Executive Council in its 39th meeting held on 18.10.2018 on the recommendations of the AC</th><th>Amendments Proposed</th></tr> <tr> <td>(a) Schools of Studies:</td><td>(a) Schools of Studies:</td></tr> <tr> <td>(i) School of Humanities and Social Sciences</td><td>(i) School of Humanities and Social Sciences</td></tr> </table>	Amendment approved by the Executive Council in its 39 th meeting held on 18.10.2018 on the recommendations of the AC	Amendments Proposed	(a) Schools of Studies:	(a) Schools of Studies:	(i) School of Humanities and Social Sciences	(i) School of Humanities and Social Sciences
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(a) Schools of Studies:	(a) Schools of Studies:						
(i) School of Humanities and Social Sciences	(i) School of Humanities and Social Sciences						

(ii) School of Interdisciplinary Studies and Applied Sciences	(ii) School of Interdisciplinary and Applied Sciences
(iii) School of Basic Sciences	(iii) School of Basic Sciences
(iv) School of Law	(iv) School of Law
(v) School of Engineering and Technology	(v) School of Engineering and Technology
(vi) School of Business and Management Studies	(vi) School of Business and Management Studies
(vii) School of Education	(vii) School of Education
(viii) <u>School of Medical Sciences</u>	(viii) To be deleted
(ix) School of Agricultural Sciences	(ix) School of Agricultural Sciences
(x) School of Life-long Learning	(x) School of Life-long Learning

(b) Departments of Studies

Amendment approved by the Executive Council in its 39th meeting held on 18.10.2018 on the recommendations of the AC	Proposed Amendments
1. Department of Agri-business	1. Department of Agri-business
2. Department of Agricultural Economics	2. Department of Agricultural Economics
3. Department of Anthropology	3. Department of Anthropology
4. Department of Biochemistry	4. Department of Biochemistry
5. Department of Bio-informatics	5. Department of Bio-informatics
6. Department of Biotechnology	6. Department of Biotechnology
7. Department of Botany	7. Department of Botany
8. Department of Buddhist Studies	8. Department of Buddhist Studies
9. Department of Chemistry	9. Department of Chemistry
10. Department of Commerce	10. Department of Commerce
11. Department of Comparative Literature & Translation Studies	11. Department of Comparative Literature & Translation Studies
12. Department of Computer Sciences and Information Technology	12. Department of Computer Sciences and Information Technology
13. Department of Earth Sciences	13. Department of Earth Sciences
14. Department of Economics	14. Department of Economics
15. Department of Education	15. To be deleted
16. Department of Electronics and Communication Engineering	16. Department of Electronics and Communication Engineering

17. Department of English and Foreign Languages	17. Department of English and Foreign Languages
18. Department of Environmental Studies	18. Department of Environmental Studies
19. Department of Food Science and Technology	19. Department of Food Science and Technology
20. Department of Genetics	20. Department of Genetics
21. Department of Geography	21. Department of Geography
22. Department of Geotechnical Engineering	22. Department of Geotechnical Engineering
23. Department of Hindi and Indian Languages	23. Department of Hindi
24. Department of History and Archaeology	24. Department of History and Archaeology
25. Department of Horticulture	25. Department of Horticulture
26. Department of Journalism and Mass Communication	26. Department of Journalism and Mass Communication
27. Department of Law	27. Department of Law
28. Department of Library and Information Science	28. Department of Library and Information Science
29. Department of Management Studies	29. Department of Management Studies
30. Department of Mathematics	30. Department of Mathematics
31. Department of Microbiology	31. Department of Microbiology
32. Department of Mycology and Plant Pathology	32. Department of Mycology and Plant Pathology
33. Department of Nano Science Technology	33. Department of Nano Science and Nano Technology
34. Department of Nutrition Biology	34. Department of Nutrition Biology
35. Department of Operations Research	35. Department of Operations Research
36. Department of Philosophy	36. Department of Philosophy
37. Department of Physical Education and Sports	37. Department of Physical Education and Sports
38. Department of Physics and Astrophysics	38. Department of Physics and Astrophysics
39. Department of Policy Studies	39. Department of Policy Studies
40. Department of Political Science	40. Department of Political Science
41. Department of Post-harvest Technology	41. Department of Post-harvest Technology
42. Department of Psychology	42. Department of Psychology
43. Department of Public Administration	43. Department of Public Administration
44. Department of Remote Sensing and Geo Informatics	44. Department of Remote Sensing and Geo Informatics

45. Department of Sociology	45. Department of Sociology
46. Department of Statistics	46. Department of Statistics
47. Department of Tourism and Hotel Management	47. Department of Tourism and Hotel Management
48. Department of Urdu	48. Department of Urdu
49. Department of Virology	49. Department of Virology
50. Department of Women's Studies and Development	50. Department of Women's Studies and Development
51. Department of Zoology	51. Department of Zoology
52. Department of Civil Engineering	52. Department of Civil Engineering
53. Department of Computer Science and Engineering	53. Department of Computer Science and Engineering
54. Department of Electrical Engineering	54. Department of Electrical Engineering
55. Department of Printing and Packaging Technology	55. Department of Printing and Packaging Technology
56. Department of Mechanical Engineering	56. To be deleted
57. Department of Social Work	57. Department of Social Work
58. Department of Sanskrit	58. Department of Sanskrit
59. Department of Yoga	59. Department of Yoga
	60. Department of Pharmaceutical Sciences

4. Resolved that, in pursuance of the comments of the UGC received vide MHRD letter No.F.58-6/2018-CU.III dated 20.05.2019, the following amendments to Ordinance-IV(A) (Qualifications for appointment to the teaching and other posts) of the University, be approved and recommended to the Executive Council for consideration:

Sr. No.	Amendment approved by the Executive Council in its 39 th meeting held on 18.10.2018 on the recommendations of the AC	Amendments Proposed
1.	<p>The qualifications for appointment to the following posts shall be those as prescribed under the UGC Regulations on "Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education, 2018" as amended from time to time:</p> <ol style="list-style-type: none"> 1. Senior Professor 2. Professor 3. Associate Professor 	<p>The qualifications for appointment to the following posts shall be those as prescribed under the UGC Regulations on "Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education, 2018" as amended from time to time:</p> <ol style="list-style-type: none"> 1. Senior Professor 2. Professor 3. Associate Professor

	<p>4. Assistant Professor</p> <p>5. Librarian/ Dy. Librarian/ Assistant Librarian</p> <p>6. Director/ Deputy Director/ Assistant Director of Physical Education & Sports.</p> <p>7. Any other post/s qualifications for which are prescribed under the UGC Regulations.</p> <p>Provided that the University may prescribe specialized and desirable qualifications, whenever needed.</p> <p>Provided further that the Executive Council of the University may prescribe guidelines for short listing of candidates to be called for interview for the teaching and other posts.</p>	<p>4. Assistant Professor</p> <p>5. Librarian/ Dy. Librarian/ Assistant Librarian</p> <p>6. Director/ Deputy Director/ Assistant Director of Physical Education & Sports.</p> <p>7. Any other post/s qualifications for which are prescribed under the UGC Regulations.</p> <p>The academic score as specified in Appendix-II (Table-3A) of UGC Regulations on "Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education, 2018", shall be considered for shortlisting of candidates for interview only, and the selection shall be based only on the performance in the interviews.</p>						
5.	<p>Resolved that, in pursuance of the comments of the UGC received vide MHRD letter No.F.58-6/2018-CU.III dated 20.05.2019, the following amendments to Ordinance-IV(B)- Career Advancement Scheme (CAS), of the University, be approved and recommended to the Executive Council for consideration:</p>							
	<table border="1"> <thead> <tr> <th>Sr. No.</th><th>Amendment approved by the Executive Council in its 39th meeting held on 18.10.2018 on the recommendations of the AC</th><th>Amendments Proposed</th></tr> </thead> <tbody> <tr> <td>1.</td><td> <p><u>1(A)- Career Advancement Scheme (CAS)-2010</u></p> <p>(a) The teachers of the University shall be eligible to be considered for up gradation/ promotion under the Career Advancement Scheme (CAS)-2010 of the University Grants Commission, as amended from time to time.</p> <p>(b) The Selection Committee for considering promotion as Professor, Associate Professor under CAS-2010 shall be the same as prescribed under Statute 18 of the Statutes of the University for appointment to these posts.</p> <p>Provided that the Screening-Evaluation Committee/ Selection Committee for promotion of an Assistant Professor from</p> </td><td> <p><u>1(A)- Career Advancement Scheme (CAS)-2010</u></p> <p>(a) The teachers of the University shall be eligible to be considered for up gradation/ promotion under the Career Advancement Scheme (CAS)-2010 of the University Grants Commission, as amended from time to time.</p> <p>(b) The Selection Committee for considering promotion as Professor, Associate Professor under CAS-2010 shall be the same as prescribed under Statute 18 of the Statutes of the University for appointment to these posts.</p> <p>Provided that the Screening-Evaluation Committee/ Selection Committee for promotion of an Assistant Professor from</p> </td></tr> </tbody> </table>	Sr. No.	Amendment approved by the Executive Council in its 39 th meeting held on 18.10.2018 on the recommendations of the AC	Amendments Proposed	1.	<p><u>1(A)- Career Advancement Scheme (CAS)-2010</u></p> <p>(a) The teachers of the University shall be eligible to be considered for up gradation/ promotion under the Career Advancement Scheme (CAS)-2010 of the University Grants Commission, as amended from time to time.</p> <p>(b) The Selection Committee for considering promotion as Professor, Associate Professor under CAS-2010 shall be the same as prescribed under Statute 18 of the Statutes of the University for appointment to these posts.</p> <p>Provided that the Screening-Evaluation Committee/ Selection Committee for promotion of an Assistant Professor from</p>	<p><u>1(A)- Career Advancement Scheme (CAS)-2010</u></p> <p>(a) The teachers of the University shall be eligible to be considered for up gradation/ promotion under the Career Advancement Scheme (CAS)-2010 of the University Grants Commission, as amended from time to time.</p> <p>(b) The Selection Committee for considering promotion as Professor, Associate Professor under CAS-2010 shall be the same as prescribed under Statute 18 of the Statutes of the University for appointment to these posts.</p> <p>Provided that the Screening-Evaluation Committee/ Selection Committee for promotion of an Assistant Professor from</p>	
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	<p>one Academic Grade Pay (AGP) to the next AGP shall consist of the following:</p> <ol style="list-style-type: none"> 1. The Vice-Chancellor or his nominee - Chairperson 2. The Dean of the concerned School 3. The Head of the concerned Department 4. One Subject Expert drawn from a panel approved by the Academic Council. 5. An academician representing SC/ST/OBC/PWD/Minority/Women to be nominated by the Vice-Chancellor, if any of the candidates representing these categories is an applicant and if any of the above members of the Selection Committee does not belong to that category. <p>Three members including the Chairperson and the expert shall form the quorum.</p>	<p>one Academic Grade Pay (AGP) to the next AGP shall consist of the following:</p> <ol style="list-style-type: none"> 1. The Vice-Chancellor - Chairperson 2. The Dean of the concerned School 3. The Head of the concerned Department 4. One Subject Expert drawn from a panel approved by the Academic Council. 5. An academician representing SC/ST/OBC/PWD/Minority/Women to be nominated by the Vice-Chancellor, if any of the candidates representing these categories is an applicant and if any of the above members of the Selection Committee does not belong to that category. <p>Three members including the Chairperson and the expert shall form the quorum.</p> <p>(c) Regarding the cases pending for promotions from one Academic Level/Grade Pay to another Academic Level/Grade Pay under the Career Advancement Scheme provided under the UGC Regulation on Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the maintenance of Standards in Higher Education-2010 and its subsequent amendments, the teachers shall be given the option to be considered for the promotion from one Academic Level/Grade Pay to another Academic Level/Grade pay as per the following:</p> <ol style="list-style-type: none"> 1. The teachers shall be considered for promotion from one Academic Level/Grade Pay to another as per the CAS under these Regulation. <p style="text-align: center;">OR</p> <ol style="list-style-type: none"> 2. The faculty members shall be considered for the promotion from one Academic Level/Grade pay to another as per the CAS provided under the UGC Regulations on Minimum Qualifications for Appointment of Teachers and Other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education-2010 and its amendments with relaxation in the requirements of Academic Performance Indicators (API) based
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Performance Based Appraisal System (PBAS) upto the date of notification of these Regulations.

The relaxation in the requirements of Academic Performance Indicators (API) based Performance Based Appraisal System, promotion from one Academic Level/Grade Pay to another under CAS as provided in UGC Regulations on Minimum Qualifications for Appointment of Teachers and Other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education 2010 and its amendments, is defined as Under:

i) Exemption from scoring under Category-I, as defined in Appendix-III of said above mentioned UGC Regulations on Minimum Qualifications for Appointment of Teachers and Other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education 2010 and its amendments including University Grants Commission (Minimum Qualification for Appointments of Teachers and Other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education (4th Amendment) Regulations, 2016, for faculty and other equivalent cadre positions.

ii) Scoring in Category-II and Category-III for faculty and other equivalent cadre positions shall be as provided for in the UGC Regulations in Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education-2010 with the following combined minimum API score requirement for Category-II and Category-III taken together, as mentioned in the UGC Regulations.

Note: There shall be no minimum API score requirement for Category-III individually.

	<p><u>1(B) Career Advancement Scheme (CAS)-2018</u></p> <p>(a) The teachers of the University shall be eligible to be considered for promotion under the Career Advancement Scheme (CAS) as provided under the UGC Regulations on "Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education, 2018", as amended from time to time.</p> <p>(b) The Selection Committees for considering promotion as Professor, Associate Professor under the Career Advancement Scheme shall be the same as prescribed under Statute 18 of the Statutes of the University for appointment to these posts.</p> <p>Provided that the Screening-Evaluation Committee for promotion of an Assistant Professor from one Academic Level of Pay (ALP) to the next ALP shall consist of the following:</p> <ol style="list-style-type: none"> 1. The Vice-Chancellor or his/her nominee - Chairperson 2. The Dean of the School concerned 3. The Head of the Department concerned 4. One Subject Expert drawn from a panel approved by the Academic Council, nominated by the Vice-Chancellor 	<p><u>1(B) Career Advancement Scheme (CAS)-2018</u></p> <p>(a) The teachers of the University shall be eligible to be considered for promotion under the Career Advancement Scheme (CAS) as provided under the UGC Regulations on "Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education, 2018", as amended from time to time.</p> <p>(b) The constitution of the Selection Committees and Selection Procedure as well as the Assessment Criteria and Methodology for the above cadres, either through direct recruitment or through Career Advancement Scheme, shall be in accordance with the UGC Regulations on Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher Education, 2018.</p> <p>Provided that the Screening-Evaluation Committee for promotion of an Assistant Professor from one Academic Level of Pay (ALP) to the next ALP shall consist of the following:</p> <ol style="list-style-type: none"> 1. The Vice-Chancellor - Chairperson 2. The Dean of the School concerned 3. The Head of the Department concerned 4. One Subject Expert drawn from a panel approved by the Academic Council, nominated by the Vice-Chancellor
2.	<p>2(a) The Assistant Librarian and Assistant Director of Physical Education & Sports shall be eligible to be considered for promotion under the Career Advancement Scheme as provided under the UGC Regulations on "Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of</p>	<p>2(a) The Assistant Librarian and Assistant Director of Physical Education & Sports shall be eligible to be considered for promotion under the Career Advancement Scheme as provided under the UGC Regulations on "Minimum Qualifications for Appointment of Teachers and other Academic Staff in Universities and Colleges and Measures for the Maintenance of Standards in Higher</p>

	<p>Standards in Higher Education, 2018", as amended from time to time.</p> <p>(b) The Screening-Evaluation Committee for considering promotion of an Assistant Librarian, shall consist of the following:</p> <ol style="list-style-type: none"> 1. The Vice-Chancellor or his/her nominee - Chairperson 2. The Dean of the School concerned 3. One expert who is working Librarian, nominated by the Vice-Chancellor from the University panel of experts. 4. The Librarian, University Library <p>(c) The Screening-Evaluation Committee for considering promotion of an Assistant Director of Physical Education & Sports, shall consist of the following:</p> <ol style="list-style-type: none"> 1. The Vice-Chancellor or his/her nominee - Chairperson; 2. The Dean of the School concerned; 3. The University Director, Physical Education & Sports; 4. One expert in Physical Education & Sports Administration from University system nominated by the Vice-Chancellor from the University panel of experts. <p>Three members including subject expert/University nominee for the selection committees under 1 and 2 above, shall form the quorum.</p>	<p>Education, 2018", as amended from time to time.</p> <p>(b) The Screening-Evaluation Committee for considering promotion of an Assistant Librarian, shall consist of the following:</p> <ol style="list-style-type: none"> 1. The Vice-Chancellor - Chairperson 2. The Dean of the School concerned 3. One expert who is working Librarian, nominated by the Vice-Chancellor from the University panel of experts. 4. The Librarian, University Library <p>(c) The Screening-Evaluation Committee for considering promotion of an Assistant Director of Physical Education & Sports, shall consist of the following:</p> <ol style="list-style-type: none"> 1. The Vice-Chancellor - Chairperson; 2. The Dean of the School concerned; 3. The University Director, Physical Education & Sports; 4. One expert in Physical Education & Sports Administration from University system nominated by the Vice-Chancellor from the University panel of experts. <p>Three members including subject expert/University nominee for the selection committees under 1 and 2 above, shall form the quorum.</p> <p>(d) The Screening-cum-Evaluation Committee on verification/evaluation of grades secured by the candidate through the assessment criteria and methodology proforma designed by the respective University based on these Regulations and as per the minimum requirement specified:</p> <ol style="list-style-type: none"> i) In Appendix-II, Table-1 for each of the cadre of Assistant Professor, ii) In Appendix-II, Table-4 for each of the cadre of Librarian; and iii) In Appendix-II, Table-5 for each of the cadre Physical Education and Sports
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		<p>The Screening cum Evaluation Committee shall recommend to the Executive Council of the University about the suitability for the promotion of the candidate(s) under CAS for implementation.</p> <p>(e) The selection process shall be completed on the day/last day of the selection committee meeting wherein the minutes are recorded and recommendation made on the basis of the performance of the interview are duly signed by all members of the selection committee.</p> <p>(f) For all Selection Committees specified in these Regulations, Head of Department/Teacher-Incharge should be either in the same or higher rank/position than the rank/position for which the interview is to be held.</p>
3	<p>Provided that while considering the candidates under both the categories 1 & 2 above:</p> <p>(i) In case the Selection Committee finds that a candidate is not suitable for promotion, it may consider him/her for promotion after one year. In such a case, his/her eligibility for promotion shall be deferred by one year.</p> <p>(ii) Every candidate will be required to appear for interview before the Selection Committee unless on a request from any candidate the Selection Committee agrees to consider him/her in absentia.</p> <p>(iii) In case of any dispute with regard to information given by the candidate in his/her self-assessment proforma, the decision of the Selection Committee shall be final.</p>	<p>Provided that while considering the candidates under both the categories 1 & 2 above:</p> <p>(i) In case the Selection Committee finds that a candidate is not suitable for promotion, it may consider him/her for promotion after one year. In such a case, his/her eligibility for promotion shall be deferred by one year.</p> <p>(ii) Every candidate will be required to appear for interview before the Selection Committee unless on a request from any candidate the Selection Committee agrees to consider him/her in absentia.</p> <p>(iii) In case of any dispute with regard to information given by the candidate in his/her self-assessment proforma, the decision of the Selection Committee shall be final.</p> <p>(iv) The candidate shall offer himself/herself for assessment for promotion, if he/she fulfils the minimum grading specified in the relevant assessment criteria and methodology tables, by submitting an application and the required assessment criteria and methodology proforma. He/she can do so three months before the due date. The University shall send a general circular twice a year, inviting applications for CAS promotion form the eligible candidates.</p> <p>a) If a candidates applies for promotion on completion of the minimum eligibility period and is successful, the date of</p>

		<p>promotion shall be from that of minimum period of eligibility.</p> <p>b) If, however, the candidate finds that he/she would fulfil the CAS promotion criteria, as defined in Tables-1,2,4 and 5 of Appendix-II at a later date and applies on that date and is successful, his/her promotion shall be effected from that date of candidate fulfilling the eligibility criteria.</p> <p>c) The candidate who does not succeed in the first assessment, he/she shall have to be re-assessed only after one year. When such a candidate succeeds in the eventual assessment, his/her promotion shall be deemed to be one year from the date of rejection.</p>
6.	The agenda item for treating the 2nd semester(2018-19) as zero semester on medical grounds, in respect of Mr. Ansuman Bera, a student of the Department of Chemistry, was withdrawn.	
7.	Resolved that the University Grants Commission (Redressal of Grievances of Students) Regulations 2019, be adopted for implementation.	
	(Annexure-I, Page No- 19 to 26)	
8.	Resolved that the recommendation of the Board of Studies of the Department of Physics dated 28.03.2019 and School Board of School of Physical and Mathematical Sciences dated 28.03.2019, for the scheme and syllabi of course work for Ph.D. programme in Physics, w.e.f. the Academic Session-2019-20, be referred to the Standing Committee on Academic matters of the Academic Council for examination and review.	
9.	Resolved that the recommendation of the Board of Studies of the Department of Physics dated 28.03.2019 and School Board of School of Physical and Mathematical Sciences dated 28.03.2019, for revision of the scheme and syllabi of M.Sc. Physics (Semesters I to IV), w.e.f. the Academic Session-2019-20, be referred to the Standing Committee on Academic matters of the Academic Council for examination and review.	
10.	Resolved that the recommendation of the Board of Studies of the Department of Environmental Studies dated 12.03.2019 and School Board of School of Earth, Environment and Space Studies dated 09.05.2019, for revision of the scheme and credit points for course curriculum of M.Sc. (Environmental Science), w.e.f. the Academic Session-2019-20, be referred to the Standing Committee on Academic matters of the Academic Council for examination and review.	
11.	Resolved that the recommendation of the Board of Studies of the Department of Environmental Studies dated 12.03.2019 and School Board of School of Earth, Environment and Space Studies dated 09.05.2019, for the syllabi of newly introduced subjects (Semester-I: 'Elementary Mathematics for Environmental Sciences' / 'Elementary Biology for Environmental Sciences' & 'Statistical approaches in Environmental Sciences'; Semester-II: 'Solid and Hazardous Waste Management' & 'Agriculture and Environment'), w.e.f. the Academic Session-2019-20, be referred to the Standing Committee on Academic matters of the Academic Council for examination and review.	

12.	Resolved that the recommendation of the Board of Studies of the Department of Environmental Studies dated 12.03.2019 and School Board of School of Earth, Environment and Space Studies dated 09.05.2019, for revision of the syllabus of M.Sc. (Environmental Sciences) for Semesters-I to IV, w.e.f. the Academic Session-2019-20, be referred to the Standing Committee on Academic matters of the Academic Council for examination and review.
13.	Resolved that the recommendation of the Board of Studies of the Department of Geography dated 11.03.2019 and School Board of School of Earth, Environment and Space Studies dated 09.05.2019, for revision of the syllabus of M.Sc. (Geography) for Semesters-I to IV, w.e.f. the Academic Session 2019-20, be referred to the Standing Committee on Academic matters of the Academic Council for examination and review.
14.	Resolved that the recommendation of the Board of Studies of the Department of Geography dated 11.03.2019 and School Board of School of Earth, Environment and Space Studies dated 09.05.2019, for addition of "Geography of Rural Development" as a Discipline Centric Elective Course in 4 th Semester for the batches of 2018-20 and 2019-21 onwards, be referred to the Standing Committee on Academic matters of the Academic Council for examination and review.
15.	Resolved that the recommendation of the Board of Studies of the Department of Nutrition Biology dated 14.02.2019 and School Board of School of Life Sciences dated 27.04.2019, for revision of the scheme and syllabi of M.Sc. (Nutrition Biology) for Semesters I to IV, w.e.f. the Academic Session-2019-20, be approved, subject to revision of subject codes logically. (Annexure-II, Page No- 27 to 96)
16.	Resolved that the recommendation of the Board of Studies of the Department of Microbiology dated 06.03.2019 and School Board of the School of Life Sciences dated 27.04.2019, for revision of the scheme and syllabi of M.Sc. (Microbiology) for Semesters I to IV, w.e.f. the Academic Session-2019-20, be approved. (Annexure-III, Page No- 97 to 156)
17.	Resolved that the recommendation of the Board of Studies of the Department of Biotechnology dated 19.02.2019 and School Board of the School of Life Sciences dated 27.04.2019, for revision of the scheme and syllabi of M.Sc. (Biotechnology) for Semesters I to IV, w.e.f. the Academic Session-2019-20, be approved. (Annexure-IV, Page No- 157 to 215)
18.	Resolved that the recommendation of the Board of Studies of the Department of Biochemistry dated 28.02.2019 and School Board of the School of Life Sciences dated 27.04.2019, for revision of the scheme and syllabi of M.Sc. (Biochemistry) for Semesters I to IV, w.e.f. the Academic Session-2019-20, be approved. (Annexure-V, Page No- 216 to 276)
19.	Resolved that the recommendation of the School Board of School of Life Sciences dated 27.04.2019, for revision of the scheme and syllabi of course work for Ph.D. programme in the Department of Biotechnology, w.e.f. the Academic Session-2019-20, be referred back for approval of the Board of Studies of the Department.
20.	Resolved that the recommendation of the School Board of School of Life Sciences dated 27.04.2019, for revision of the scheme and syllabi of course work for Ph.D. programme in the Department of Microbiology, w.e.f. the Academic Session-2019-20, be referred back for approval of the Board of Studies of the Department.

21.	Resolved that the recommendation of the School Board of School of Life Sciences dated 27.04.2019, for revision of the scheme and syllabi of course work for Ph.D. programme in the Department of Nutrition Biology, w.e.f. the Academic Session-2019-20, be referred back for approval of the Board of Studies of the Department.
22.	Resolved that the recommendation of the School Board of School of Life Sciences dated 27.04.2019, for revision of the scheme and syllabi of course work for Ph.D. programme in the Department of Biochemistry, w.e.f. the Academic Session-2019-20, be referred back for approval of the Board of Studies of the Department.
23.	Resolved that the syllabi of M.A. (Sanskrit) for Semesters I to II, as recommended by the Board of Studies of the Department of Sanskrit on 20.06.2019, to be implemented w.e.f. the Academic Session-2019-20, be approved. (Annexure-VI, Page No- 277 to 294)
24.	Resolved that the syllabi of M.Sc. (Yoga) for Semesters I to II, as recommended by the Board of Studies of the Department of Yoga on 06.06.2019, to be implemented w.e.f. the Academic Session-2019-20, be approved. Note: M.A. (Yoga) mentioned in syllabus be read as M.Sc. (Yoga). (Annexure-VII, Page No- 295 to 308)
25.	The agenda item regarding option of Apprenticeship for M.Sc. Semester-IV students, was withdrawn.
26.	Resolved that the following proposal for appointment of adjunct faculty to various departments in Central University of Haryana from amongst the regular faculty in the University, be approved. <i>(i) To encourage interdisciplinary approach in teaching and research at Central University of Haryana, it is proposed to have a provision of adjunct faculty from the regular faculty working in the University. While the administrative control and primary duties of the faculty will be in the parent department of their original recruitment. They may be permitted to associate as adjunct faculty with another department of the University for the purpose of teaching and research including guidance of Masters, M.Phil. and Ph.D. students in the department where they would be associated as adjunct faculty.</i> <i>(ii) To be appointed as adjunct faculty in a Department, a faculty may apply to the Vice-Chancellor through his Head and Dean indicating the name of the secondary department he/she would like to associate with, along with a summary of the proposed teaching and research programme to be undertaken by him/her in the secondary department or Head of Department may request for an adjunct faculty if needed.</i>
27.	The Council considered and accepted in principle the proposal for introduction of a new course titled, "Continuous Evaluation" in the course work for the Ph.D. programmes in all the departments of studies of the University and resolved that a revised proposal may be submitted in next meeting after wider consultations.
28.	Resolved that the recommendation of the Board of Studies of the Department of Civil Engineering dated 11.06.2019, for the addition of "Project Cost Analysis" as a Discipline Centric Elective Course in 7 th Semester for the batches of 2016-20 and 2017-21, be referred back for approval of the School Board of the School of Engineering and Technology.
29.	Resolved that the recommendation of the Board of Studies of the Department of Civil Engineering dated 11.06.2019, for the revision of syllabi for "Building Construction (BTCE-409)" for the 4 th

	semester, w.e.f the Academic Session 2019-20, be referred back for approval of the School Board of the School of Engineering and Technology.								
30.	Resolved that the recommendation of the Board of Studies dated 21.02.2019 of the Department of Sociology, for revision of the syllabi of M.Phil. /Ph.D. course work, w.e.f. the Academic Session-2019-20, be referred back for approval of the School Board of the School of Arts, Humanities and Social Sciences.								
31.	<p>Resolved that the proposal for introduction of the following three year Undergraduate programmes from the next Academic Session (2020-21), be approved, in principle:</p> <table border="0"> <tr> <td>1. B.A (Hons)-English</td><td>2. B.Sc. (Hons) Physics</td></tr> <tr> <td>3. B.A (Hons)-Economics</td><td>4. B.Sc. (Hons) Chemistry</td></tr> <tr> <td>5. B.Com (Hons)</td><td>6. B.Sc. (Hons) Mathematics</td></tr> <tr> <td>7. B.Sc. (Hons) Applied Psychology</td><td></td></tr> </table>	1. B.A (Hons)-English	2. B.Sc. (Hons) Physics	3. B.A (Hons)-Economics	4. B.Sc. (Hons) Chemistry	5. B.Com (Hons)	6. B.Sc. (Hons) Mathematics	7. B.Sc. (Hons) Applied Psychology	
1. B.A (Hons)-English	2. B.Sc. (Hons) Physics								
3. B.A (Hons)-Economics	4. B.Sc. (Hons) Chemistry								
5. B.Com (Hons)	6. B.Sc. (Hons) Mathematics								
7. B.Sc. (Hons) Applied Psychology									
32.	<p>Resolved that the proposal for introduction of 5-year integrated BS-MS programme in the following Departments of the University, having an exit option after 3 years with a BS degree and a 5 year dual degree (BS-MS) after final year (5th Year) dedicated to research in respective field, from the next academic session (2020-21), be approved, in principle:</p> <ol style="list-style-type: none"> 1. Department of Physics 2. Department of Chemistry 3. Department of Mathematics 4. Department of Statistics 5. Department of Biochemistry 6. Department of Environment Studies 7. Department of Biotechnology 8. Department of Microbiology 9. Department of Nutrition Biology 								

CONCEPT NOTE

Background:

Central University of Haryana (CUH) offers the following Masters degree courses in its various science departments: Physics, Chemistry, Mathematics, Biochemistry, Biotechnology, Microbiology, Nutrition Biology and Environmental Sciences. The entry-level qualification for these courses is graduation in respective or related disciplines. Experience has shown that graduates entering in these courses are not always fully equipped to take complete benefit from these Masters Courses, since such graduates have either been prepared in mathematical/ physical sciences or in biological sciences but rarely in inter-disciplinary areas. Secondly, there is lot of avoidable redundancy in the syllabi of entry-level graduation degree courses and the Masters level syllabi currently being offered by CUH. As a consequence of this, some of the bright and motivated students are unable to keep their enthusiasm during the Master courses at CUH.

If we are to compete internationally in quality research and innovation we need to produce top-notch research students with strong and deep knowledge in core subjects and at the same time having breadth in related subjects. Cutting edge meaningful contributions in knowledge generation requires networking of man-power with diverse but inter-related subjects such that in their given specialisation they are the leaders and in related subjects they are able to establish productive communication with other specialists. Most of the time real breakthrough in sciences happens where

the traditional boundaries of different specialisations meet. Even at the national level post-graduates from Central University of Haryana need to compete with students being produced by various IISERs and NISERs in the country. In the latter institutions teaching and research have been pitched at next higher levels, and therefore, to stay relevant, Central University needs to rethink its post-graduate programmes in sciences.

Committee for Draft National Education Policy (Chair: Dr. K. Kasturirangan), has envisaged re-organization of **higher education institutions** into three categories: (i) research universities focusing equally on research and teaching; (ii) teaching universities focusing primarily on teaching; and (iii) colleges focusing only on teaching at undergraduate levels. Obviously, the Central University of Haryana would strive to belong to the first category with world-class research capabilities in terms of infrastructure and faculty and produce internationally competitive post-graduates ready to join and lead research and innovation ecosystem in the country and abroad.

To give impetus to inter-disciplinary approach in teaching and research at Central University of Haryana efforts are already on to integrate various existing science departments under 1) School of Basic Sciences, and 2) School of Interdisciplinary and Applied Sciences. To further enhance this integration of teaching and cutting-edge research across all the disciplines, it is proposed that a five-year dual degree programme for bright and highly motivated science students may be started. The Central University of Haryana may offer BS-MS (Dual Degree) in Physics, Chemistry, Mathematics, Biochemistry, Biotechnology, Microbiology, Nutrition Biology and Environmental Sciences. It is proposed that the on-going postgraduate courses in all these departments would be phased out with time once the entrants in the proposed Dual-Degree Programme would be ready to enter fourth year of their studies. Like IISERs/ NISERs, entry to these Dual Degree programmes should be on the basis of marks obtained by candidates in JEE main and advanced tests. Such candidate would have earlier passed Plus-Two level examination with mathematics, physics, and chemistry as major subjects and obtained a first division.

Objectives:

The Central University of Haryana BS-MS dual degree programme would aim to integrate the conventional bachelors and masters programs into a more holistic science education experience, bringing together the biological, chemical, mathematical, physical and environmental sciences and challenging the brightest young minds in an empowered ecosystem under the guidance and supervision of internationally acclaimed science leaders in the country. Specific objectives of Dual Degree BS-MS programme would be:

- 1) To develop and establish integrated Institute of learning and teaching in Core Sciences with world-class Faculty - Initiate Integrated BS-MS (Dual Degree) Programs in Science subjects (Physics, Chemistry, Mathematics, Statistics, Biochemistry, Biotechnology, Nutrition Biology, Microbiology, Environmental Sciences)
- 2) To attract highly motivated and very bright young students and provide them with a challenging ecosystem through classroom learning along with research and opportunities for multidisciplinary interactions with leading academician and researchers.
- 3) Quality research training of two semesters during dual degree BS-MS programme so that the students will be ready to pursue research careers in industries, research institutes, and academia in India and abroad.

Mission & Vision:

- To enable students to join Central University of Haryana at young age to train themselves for a dual degree in basic and applied sciences.

- To produce knowledgeable and empowered skilled manpower in the field of core fundamental and applied science subjects.
- To provide real time research experience for preparation towards for higher research degree.
- To build and run state-of-art research facilities for learning in different areas.
- To impart knowledge and capabilities at par with IISERs, NISERs, and IITs
- To conduct national and International workshops and training programmes for faculty.

Broad Structure:

The curriculum of the BS-MS degrees will have total ten semesters, out of which eight semesters of courses- including laboratory, tutorials and lecture courses, and semester-long projects and summer internships, and the remaining two semesters of a Masters research Project.

The curricular structure will have first three semesters of courses in all branches of the sciences, viz, Mathematics, Physics, Chemistry, Biology including Environmental Sciences, Humanities, Languages, and several other courses of a trans-disciplinary or foundational nature. Starting with the third semester and into the fourth semester, students will have the option of choosing two disciplines as pre-major choices, moving on to one discipline as the major discipline. Students who wish to major in a particular discipline will be mandated to successfully complete a set of courses prescribed for that discipline. The last two semesters would not involve any course work, so that students focus entirely on their research project, which they would have an opportunity to complete with a faculty at Central University of Haryana or in a leading research institution in India, or abroad.

Exit Option:

After four semesters a student may be given an option of exiting the dual-degree programme with an opportunity to earn a B.S degree in a given discipline. Such students will have to complete an extensive set of courses specific to one of the above proposed disciplines during third year. The curriculum during third year for such candidates will be a blend of applied and basic courses in their specialised subject so that the graduates will have reasonable chance of finding employment in the industry, if they opt for the same.

Challenges and Opportunities of Starting Dual Degree Programme at Central University of Haryana:

For the success of a Dual- Degree programme with an entry of very bright and highly motivated students, one would need to meet the following challenges:

- Recruitment of internationally acclaimed, highly competent and motivated faculty in various disciplines who have a real passion for science research and teaching.
- Quality research infrastructure and laboratories in all disciplines. Thus, there will be a need to provide for massive resources for research and teaching laboratories.
- Assured hostel facility for all students. To maximise the benefit of such an intensive course, students will be required to reside in the campus.
- Library with online resources, books, and research journals.
- Quality sports and recreational facilities for enrichment of academic ecosystem.

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| 33. | Resolved that the proposal for adoption of the existing scheme and syllabi of course work for Ph.D. programme of the Department of Education for the newly introduced Ph.D. programme in the School of Education, w.e.f. the Academic Session-2019-20, be approved. |
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REPORTING ITEMS

34.	The action taken by the Vice-Chancellor on 03.04.2019, in approving the Fee Structure for the students of UG/PG/M.Phil./Ph.D. programmes, Instructions of Fee Payment, Other Fee Payable by the Students and Refund of Fee Rules 2019-20, was reported, recorded and confirmed. (Annexure-VIII, Page No- 309 to 315)
35.	The action taken by the Vice-Chancellor on 03.04.2019, in approving the signing of Memorandum of Understanding (MoU) between Central University of Haryana and HITECH ENVIRO ENGINEERS AND CONSULTANTS PVT. LTD, was reported, recorded and confirmed. (Annexure-IX, Page No- 316 to 322)
36.	The action taken by the Vice-Chancellor on 22.05.2019, in approving the signing of Memorandum of Understanding (MoU) between Central University of Haryana and Deshwal Waste Management Pvt. Ltd. (DWMPL), was reported, recorded and confirmed. (Annexure-X, Page No- 323 to 329)
37.	The action taken by the Vice-Chancellor on 21.06.2019, in approving the signing of Memorandum of Understanding (MoU) between Central University of Haryana and CONSORTIUM FOR EDUCATIONAL COMMUNICATION (CEC), was reported, recorded and confirmed.

UNDER ANY OTHER ITEM

38.	Resolved that the Vice Chancellor be authorised to adopt new Regulations and Instructions issued by the University Grants Commission, and Government of India, Ministry of Human Resource Development, from time to time and the same may be reported to Academic Council in its subsequent meetings.
39.	Resolved that the Vice-Chancellor be authorised to constitute a Standing Committee on Academic matters of the Academic Council to examine and review the course structure, syllabi, scheme of examination and suggested readings etc. proposed to be put up for consideration of the Academic Council.
	The meeting ended with a vote of thanks to the Chair.



VICE-CHANCELLOR
(Chairperson)



REGISTRAR
(Secretary)

बशर्ते कि, इस विनियमों के तहत आयोग द्वारा कोई कार्यवाई नहीं की जाएगी, जब तक कि संस्थान को अपनी स्थिति स्पष्ट करने के लिए अवसर नहीं दिया गया हो और उसे सुने जाने का अवसर प्रदान नहीं किया गया हो।

11. इन विनियमों में उल्लिखित कोई भी शर्त, विश्वविद्यालय अनुदान आयोग (शिकायत निवारण) विनियम, 2012 के उपबंधों के तहत नियुक्त किसी पदधारी लोकपाल के कार्यकाल की अवधि के दौरान उसके पद पर बने रहने को प्रतिकूल रूप से प्रभावित नहीं करेगी; कार्यकाल समाप्त होने के पश्चात् लोकपाल, की नियुक्ति विश्वविद्यालय अनुदान आयोग (छात्रों की शिकायतों का निवारण) संबंधी विनियम, 2019 के अनुरूप की जाएगी।

प्रो. रजनीश जैन, सचिव

[विज्ञापन—III/4/असा./30/19]

UNIVERSITY GRANTS COMMISSION

NOTIFICATION

New Delhi, the 6th May, 2019

F.No. 14-4/2012(CPP-II).—In exercise of the powers conferred under clause (g) of sub-section (1) of Section 26 of the University Grants Commission Act, 1956 (3 of 1956), and in supersession of the University Grants Commission (Grievance Redressal) Regulations, 2012, the University Grants Commission hereby makes the following regulations, namely -

1. SHORT TITLE, APPLICATION AND COMMENCEMENT:

- a) These regulations shall be called as the University Grants Commission (Redress of Grievances of Students) Regulations, 2019.
- b) They shall apply to all higher education institutions, whether established or incorporated by or under a Central Act or a State Act, and every institution recognized by the University Grants Commission under clause (f) of Section 2 of the University Grants Commission Act, 1956 and to all institutions deemed to be a University declared as such under Section 3 therein.
- c) They shall come into force from the date of their publication in the Official Gazette.

2. OBJECTIVE:

To provide opportunities for redress of certain grievances of students already enrolled in any institution, as well as those seeking admission to such institutions, and a mechanism thereto.

3. DEFINITION: IN THESE REGULATIONS, UNLESS THE CONTEXT OTHERWISE REQUIRES:

- (a) “Act” means the University Grants Commission Act, 1956 (3 of 1956);
- (b) “aggrieved student” means a student, who has any complaint in the matters relating to or connected with the grievances defined under these regulations.
- (c) “college” means any institution, so defined in clause (b) of sub-section (1) of section 12A of the Act.
- (d) “Collegiate Student Grievance Redressal Committee” (CSGRC) means a committee constituted under these regulations, at the level of an institution, being a college.
- (e) “Commission” means the University Grants Commission established under section 4 of the UGC Act, 1956.
- (f) “declared admission policy” means such policy, including the process there under, for admission to a course or program of study as may be offered by the institution by publication in the prospectus of the institution.
- (g) “Departmental Student Grievance Redressal Committee” (DSGRC) means a committee constituted under these regulations, at the level of a Department, School or Centre of a University.
- (h) “grievance” means, and includes, complaint(s) made by an aggrieved student in respect of the following, namely:

- i. admission contrary to merit determined in accordance with the declared admission policy of the institution;
 - ii. irregularity in the process under the declared admission policy of the institution;
 - iii. refusal to admit in accordance with the declared admission policy of the institution;
 - iv. non-publication of prospectus by the institution, in accordance with the provisions of these regulations;
 - v. publication by the institution of any information in the prospectus, which is false or misleading, and not based on facts;
 - vi. withholding of, or refusal to return, any document in the form of certificates of degree, diploma or any other award or other document deposited by a student for the purpose of seeking admission in such institution, with a view to induce or compel such student to pay any fee or fees in respect of any course or program of study which such student does not intend to pursue;
 - vii. demand of money in excess of that specified to be charged in the declared admission policy of the institution;
 - viii. violation, by the institution, of any law for the time being in force in regard to reservation of seats in admission to different category of students;
 - ix. nonpayment or delay in payment of scholarships or financial aid admissible to any student under the declared admission policy of such institution, or under the conditions, if any, prescribed by the Commission;
 - x. delay by the institution in the conduct of examinations, or declaration of results, beyond the schedule specified in the academic calendar of the institution, or in such calendar prescribed by the Commission;
 - xi. failure by the institution to provide student amenities as set out in the prospectus, or is required to be extended by the institution under any provisions of law for the time being in force;
 - xii. non-transparent or unfair practices adopted by the institution for the evaluation of students;
 - xiii. delay in, or denial of, the refund of fees due to a student who withdraws admission within the time mentioned in the prospectus, or as may be notified by the Commission;
 - xiv. complaints of alleged discrimination of students from the Scheduled Castes, the Scheduled Tribes, Other Backward Classes, Women, Minority or persons with disabilities categories;
 - xv. denial of quality education as promised at the time of admission or required to be provided; and
 - xvi. harassment or victimization of a student, other than cases of harassment, which are to be proceeded against under the penal provisions of any law for the time being in force.
- (i) “Institution” means, as the context may be, a University or a college, or an institution declared a deemed to be a University under the Act or an institution established within a University for a particular discipline or activity;
 - (j) Institutional Student Grievance Redressal Committee” (ISGRC) means a committee constituted under these regulations at the level of the University, for dealing with grievances which do not belong to a department of the University e.g. hostels and common facilities.
 - (k) “Ombudsperson” means the Ombudsperson appointed under these regulations;
 - (l) “Prospectus” means and includes any publication, whether in print or otherwise, issued for providing fair and transparent information, relating to an institution, to the general public (including to those seeking admission in such institution) by such institution or any authority or person authorized by such institution to do so;

- (m) "Region" means a geographical territory, comprising of States, so determined, for the purpose of facilitating enforcement of these regulations; namely, South-Eastern Region comprising Andhra Pradesh, Telengana, Puducherry, Andaman and Nicobar, and Tamil Nadu; South-Western Region comprising Kerala, Karnataka, and Lakshadweep; Western Region comprising Maharashtra, Gujarat, Goa, Dadar and Nagar Haveli, Daman and Diu; Central Region comprising Chhattisgarh, Madhya Pradesh and Rajasthan; Northern Region comprising Jammu and Kashmir, Delhi, Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Uttarakhand and Chandigarh; North-Eastern Region comprising Assam, Meghalaya, Mizoram, Manipur, Tripura, Arunachal Pradesh, Sikkim and Nagaland; and Eastern Region comprising West Bengal, Bihar, Jharkhand and Odisha.
- (n) "State" means a State specified in the First Schedule to the Constitution and includes a Union territory;
- (o) "Student" means a person enrolled, or seeking admission to be enrolled, in any institution to which these regulations apply;
- (p) "University" means a University so defined in clause (f) of section 2 of the Act or, where the context may be, an institution deemed to be University declared as such under Section 3 thereof.
- (q) "University Student Grievance Redressal Committee" (USGRC) means a committee constituted under these regulations, at the level of the university, for dealing with grievances arising out of decisions of the DSGRC, ISGRC or CSGRC.

4. MANDATORY PUBLICATION OF PROSPECTUS, ITS CONTENTS AND PRICING:

- (1) Every institution, shall publish and/or upload on its website, before expiry of at least sixty days prior to the date of the commencement of the admission to any of its courses or programs of study, a prospectus containing the following for the information of persons intending to seek admission to such institution and the general public, namely:
 - (a) the list of programs of study and courses offered along with the broad outlines of the syllabus specified by the appropriate statutory authority or by the institution, as the case may be, for every course or program of study, including teaching hours, practical sessions and other assignments;
 - (b) the number of seats approved by the appropriate statutory authority in respect of each course or program of study for the academic year for which admission is proposed to be made;
 - (c) the conditions of educational qualifications and eligibility including the minimum and maximum age limit of persons for admission as a student in a particular course or program of study, specified by the institution;
 - (d) the process of selection of eligible candidates applying for such admission, including all relevant information in regard to the details of test or examination for selecting such candidates for admission to each course or program of study and the amount of fee prescribed for the admission test;
 - (e) each component of the fee, deposits and other charges payable by the students admitted to such institution for pursuing a course or program of study, and the other terms and conditions of such payment;
 - (f) rules/regulations for imposition and collection of any fines in specified heads or categories, minimum and maximum fine may be imposed.
 - (g) the percentage of tuition fee and other charges refundable to a student admitted in such institution in case such student withdraws from such institution before or after completion of course or program of study and the time within and the manner in which such refund shall be made to that student;
 - (h) details of the teaching faculty, including their educational qualifications, along with their type of appointment (Regular/visiting/guest) and teaching experience of every member thereof.
 - (i) information with regard to physical and academic infrastructure and other facilities including hostel accommodation and its fee, library, hospital or industry wherein the practical training is

to be imparted to the students and in particular the amenities accessible by students on being admitted to the institution;

- (j) all relevant instructions in regard to maintaining the discipline by students within or outside the campus of the institution, and, in particular such discipline relating to the prohibition of ragging of any student or students and the consequences thereof and for violating the provisions of any regulation in this behalf made by the relevant statutory regulatory authority; and

- (k) Any other information as may be specified by the Commission:

Provided that an institution shall publish/upload information referred to in clauses (a) to (k) of this regulation, on its website, and the attention of prospective students and the general public shall be drawn to such publication being on the website through advertisements displayed prominently in different newspapers and through other media:

- (2) Every institution shall fix the price of each printed copy of the prospectus, being not more than the reasonable cost of its publication and distribution and no profit be made out of the publication, distribution or sale of prospectus.

5. **STUDENT GRIEVANCE REDRESSAL COMMITTEES (SGRC):**

A. Collegiate Student Grievance Redressal Committee (CSGRC)

- (i) A complaint from an aggrieved student relating to a college shall be addressed to the Collegiate Student Grievance Redressal Committee (CSGRC), with the following composition, namely:
 - a) Principal of the college – Chairperson;
 - b) Three senior members of the teaching faculty to be nominated by the Principal – Members;
 - c) A representative from among students of the college to be nominated by the Principal based on academic merit/excellence in sports/performance in co-curricular activities – Special Invitee.
- (ii) The term of the members and the special invitee shall be two years.
- (iii) The quorum for the meeting including the Chairperson, but excluding the special invitee, shall be three.
- (iv) In considering the grievances before it, the CSGRC shall follow principles of natural justice.
- (v) The CSGRC shall send its report with recommendations, if any, to the Vice-Chancellor of the affiliating University and a copy thereof to the aggrieved student, within a period of 15 days from the date of receipt of the complaint.

B. Departmental Student Grievance Redressal Committee (DSGRC)

- (i) A complaint by an aggrieved student relating to a Department, or School, or Centre of a University shall be addressed to the Departmental Student Grievance Redressal Committee (DSGRC) to be constituted at the level of the Department, School, or Centre, as the case may be, and with the following composition, namely:
 - a) Head of the Department, School, or the Centre, by whatever designation known – Chairperson;
 - b) Two Professors, from outside the Department/School/Centre to be nominated by the Vice Chancellor– Members;
 - c) A member of the faculty, well-versed with the mechanism of grievance redressal to be nominated by the Chairperson– Member;
 - d) A representative from among students of the college to be nominated by the Vice Chancellor based on academic merit/excellence in sports/performance in co-curricular activities – Special Invitee.

- (ii) The term of the Chairperson, members of the Committee, and the special invitee shall be of two years.
- (iii) The quorum for the meeting of DSGRC, including the Chairperson, but excluding the special invitee, shall be three.
- (iv) In considering the grievances before it, the DSGRC shall follow principles of natural justice.
- (v) The DSGRC shall submit its report with recommendations, if any, to the Head of the Institution/ Vice Chancellor, with a copy thereof to the aggrieved student, within a period of 15 days from the date of receipt of the complaint.

C. Institutional Student Grievance Redressal Committee (ISGRC)

- (i) Where a complaint does not relate to any academic Department, School or Centre of a University, as the case may be, the matter shall be referred to the Institutional Student Grievance Redressal Committee (ISGRC) to be constituted by the Vice Chancellor, with the following composition, namely:
 - (a) Pro-Vice Chancellor/Dean/Senior Professor of institution – Chairperson;
 - (b) Dean of students/Dean, Students Welfare – Member;
 - (c) One senior academic, other than the Chairperson – Member;
 - (d) Proctor/Senior academic – Member;
 - (e) A representative from among students of the college to be nominated by the Vice Chancellor based on academic merit/excellence in sports/performance in co-curricular activities – Special Invitee.
- (ii) The term of the members of the committee shall be of two years.
- (iii) The quorum for the meetings of the ISGRC, including the Chairperson, but excluding the special invitee, shall be three.
- (iv) In considering the grievances before it, the ISGRC shall follow principles of natural justice.
- (v) The ISGRC shall send its report with recommendations, if any, to the Vice Chancellor, along with a copy thereof to the aggrieved student, within a period of 15 workings days from the date of receipt of the grievance.

D. University Student Grievance Redressal Committee (USGRC)

- (i) The Vice Chancellor of an affiliating University shall constitute such number of University Student Grievance Redressal Committees (USGRC), as may be required to consider grievances unresolved by one or more CSGRC or DSGRC or ISGRC and each USGRC may take up grievances arising from colleges/departments/ Institutions, on the basis of the jurisdiction assigned to it by the Vice Chancellor.
 - a) A senior Professor of the University – Chairperson;
 - b) Dean, Student Welfare or equivalent – Member;
 - c) Two Principals drawn from the affiliating colleges, other than those connected with reports of CSGRC under review, to be nominated by the Vice-Chancellor – Members;
 - d) One Professor of the University - Member;
 - e) A representative from among students of the college to be nominated by the Vice Chancellor based on academic merit/excellence in sports/performance in co-curricular activities – Special Invitee.
- (ii) The Chairperson, members and the special invitee shall have a term of two years.
- (iii) The quorum for the meeting, including the Chairperson, but excluding the special invitee, shall be three.

- (iv) In considering the grievances before it, the USGRC shall follow principles of natural justice.
- (v) The USGRC shall send its report and recommendations, if any, to the Principal of the College relating to the grievance/Head of the department/School/Institution with a copy thereof to the aggrieved student, within 15 days of the receipt of the grievance.
- (vi) Any student aggrieved by the decision of the University Student Grievance Redressal Committee may prefer an appeal to the Ombudsperson, within in a period of fifteen days from the date of receipt of such decision.

6. APPOINTMENT, TENURE, REMOVAL AND CONDITIONS OF SERVICES OF OMBUDSPERSON:

- (i) There shall be one or more part-time functionaries designated as Ombudspersons to hear, and decide on, appeals preferred against the decisions of the USGRCs.

Provided that, there shall not be more than one ombudsperson for a State, in respect of all the State universities (Public as well as Private) in that State, who shall be appointed by the State Government;

Provided further that, there shall not be more than one Ombudsperson for a region, in respect of the Central universities and institutions deemed to be universities in that region, who shall be appointed by the Central Government.

- (ii) The Ombudsperson shall be a person of eminence in academics or research, who had been Vice-Chancellor of a University.
- (iii) The Ombudsperson for the State universities in a State, shall not be in any conflict of interest with any University in that State; and the Ombudsperson for the Central universities and institutions deemed to be universities in a region, shall not be in any conflict of interest with any University or institution deemed to be University in that region, either before or after such appointment.
- (iv) A State Government shall appoint the Ombudsperson from a panel of three names recommended by a search committee constituted for that purpose and consisting of the following, namely:
 - (a) A nominee of the Governor or Lt. Governor, as the case may be, who is a person of eminence in the field of higher education— Chairperson;
 - (b) A Vice Chancellor from a State Public University to be nominated by the Governor/LG of the State/UT - Member;
 - (c) A Vice Chancellor from a State Private University to be nominated by the State Government – Member;
 - (d) Chairperson of the State Council of Higher Education or his/her nominee from among the academic members of the Council— Member;
 - (e) Principal Secretary/Secretary to the State Government responsible for Higher Education— Member Secretary.
- (v) The Central Government shall appoint the Ombudsperson for a region from a panel of three names recommended by a search committee to be constituted for that purpose, and consisting of the following, namely:
 - (a) Chairperson, University Grants Commission or his/her nominee – Chairperson
 - (b) A Vice Chancellor of a Central University to be nominated by the Central Government – Member
 - (c) A Vice Chancellor of an institution deemed to be University to be nominated by the Central Government – Member
 - (d) A nominee of the Central Government, not below the rank of the Joint Secretary – Member
 - (e) Secretary, University Grants Commission – Member Secretary

- (vi) The Ombudsperson shall be appointed for a period of three years or until he attains the age of 70 years, whichever is earlier, from the date of assuming office, and shall be eligible for reappointment for another one term for the same State or region, as the case may be.
- (vii) For conducting the hearings, the Ombudsperson shall be paid a sitting fee, per diem, in accordance with the norms fixed by the University Grants Commission, and shall, in addition, be eligible for reimbursement of the expenditure incurred on conveyance.
- (viii) The State Government, in the case of an Ombudsperson of a State, and the Central Government, in the case of an Ombudsperson of a region, may remove the Ombudsperson from office, on charges of proven misconduct or misbehavior as defined under these regulations.
- (ix) No order of removal of Ombudsperson shall be made except after an inquiry made in this regard by a person not below the rank of judge of the High Court in which a reasonable opportunity of being heard is given to the Ombudsperson.

7. FUNCTIONS OF OMBUDSPERSON:

- (i) The Ombudsperson shall hear appeals from an aggrieved student, only after the student has availed all other remedies provided under these regulations.
- (ii) While issues of malpractices in the conduct of examination or in the process of evaluation may be referred to the Ombudsperson, no appeal or application for revaluation or re-totalling of answer sheets from an examination, shall be entertained by the Ombudsperson unless specific irregularity materially affecting the outcome of specific instance of discrimination is indicated.
- (iii) The Ombudsperson may avail assistance of any person, as amicus curiae, for hearing complaints of alleged discrimination.
- (iv) The Ombudsperson shall make all efforts to resolve the grievances within a period of 30 days of receiving the appeal from the aggrieved student(s).

8. PROCEDURE FOR REDRESSAL OF GRIEVANCES BY OMBUDSPERSONS AND STUDENT GRIEVANCE REDRESSAL COMMITTEES:

- (i) Each institution shall, within a period of three months from the date of issue of this notification, have an online portal where any aggrieved student may submit an application seeking redressal of grievance.
- (ii) On receipt of an online complaint, the institution shall refer the complaint to the appropriate Student Grievance Redressal Committee, along with its comments within 15 days of receipt of complaint on the online portal.
- (iii) The Student Grievance Redressal Committee, as the case may be, shall fix a date for hearing the complaint which shall be communicated to the institution and the aggrieved student.
- (iv) An aggrieved student may appear either in person or authorize a representative to present the case.
- (v) Grievances not resolved by the University Student Grievance Redressal Committee shall be referred to the Ombudsperson, within the time period provided in these regulations.
- (vi) Institutions shall extend co-operation to the Ombudsperson or the Student Grievance Redressal Committee(s), as the case may be, in early redressal of grievances; and failure to do so may be reported by the Ombudsperson to the Commission, which shall take action in accordance with the provisions of these regulations.
- (vii) The Ombudsperson shall, after giving reasonable opportunities of being heard to both parties, on the conclusion of proceedings, pass such order, with reasons there for, as may be deemed fit to redress the grievance and provide such relief as may be appropriate to the aggrieved student.
- (viii) The institution, as well as the aggrieved student, shall be provided with copies of the order under the signature of the Ombudsperson, and the institution shall place it for general information on its website.

- (ix) The institution shall comply with the recommendations of the Ombudsperson; and the Ombudsperson shall report to the Commission any failure on the part of the institution to comply with the recommendations.
- (x) The Ombudsperson may recommend appropriate action against the complainant, where a complaint is found to be false or frivolous.

9. INFORMATION REGARDING OMBUDSPERSONS AND STUDENT GRIEVANCE REDRESSAL COMMITTEES:

An institution shall furnish, prominently, on its website and in its prospectus, all relevant information in respect of the Student Grievance Redressal Committee(s) coming in its purview, and the Ombudsperson for the purpose of appeals.

10. CONSEQUENCES OF NON-COMPLIANCE:

The Commission shall in respect of any institution, which willfully contravenes these regulations or repeatedly fails to comply with the recommendation of the Ombudsperson or the Grievance Redressal Committee(s), as the case may be, proceed to take one or more of the following actions, namely:

- (a) withdrawal of declaration of fitness to receive grants under section 12B of the Act;
- (b) withholding any grant allocated to the Institution;
- (c) declaring the institution ineligible for consideration for any assistance under any of the general or special assistance programs of the Commission;
- (d) informing the general public, including potential candidates for admission, through a notice displayed prominently in suitable media and posted on the website of the Commission, declaring that the institution does not possess the minimum standards for redressal of grievances;
- (e) recommend to the affiliating University for withdrawal of affiliation, in case of a college;
- (f) take such action as it may deem necessary, appropriate and fit, in case of an institution deemed to be University;
- (g) recommend to the Central Government, if required, for withdrawal of declaration as institution deemed to be a University, in case of an institution deemed to be University;
- (h) recommend to the State Government to take necessary and appropriate action, in case of a University established or incorporated under a State Act;
- (i) such other action as may be deemed necessary and appropriate against an institution for non-compliance.

Provided that no action shall be taken by the Commission under this regulation, unless the institution has been given an opportunity to explain its position and an opportunity of being heard has been provided to it.

- 11.** Nothing mentioned hereinabove in these regulations shall affect the continuance in office, during the currency of the term, of an incumbent Ombudsperson appointed under the provisions of the UGC (Grievance Redressal) Regulations, 2012; where after, the appointment of Ombudsperson shall be made as per University Grants Commission (Redress of Grievances of Students) Regulations, 2019.

Prof. RAJNISH JAIN, Secy.

[ADVT.-III/4/Exty./30/19]

Minutes of the 1st Meeting of School Board of School of Interdisciplinary and Applied Lifesciences

A meeting of School Board of SIAL held on 27/4/19 at Room No. 300 of new Academic Block-1 from 10:45 to 4:50 pm. The following members were present:

Prof. Satish Kumar, Dean, SIAL, Chairman
Prof. Neelam Sangwan, Member
Dr. Gunjan Goel, Member
Dr. Pawan Maurya, Member
Dr. Kashyap Kumar Dubey, Member
Dr. Meenu Goyal, Member
Dr. Avijit Pramanik, Member
Dr. Sanjay Kumar, Member
Dr. Savita, Member
Prof. J.S. Viridi, External Expert
Prof. Namita Singh, External Expert
Dr. Surender Singh, Special Invitee
Dr. Ashwani Kumar, Special Invitee
Dr. Piyush Kumar, Special Invitee

All the agenda items were discussed and resolved as follows:

1. School Board noted the recommendations of respective meetings of Board of Studies of Department of Microbiology, Nutrition Biology, Biochemistry and Biotechnology held during the present semester.
2. Syllabi (MSc and PhD) earlier recommended and forwarded by Board of Studies of Department of Microbiology, Nutrition Biology, Biochemistry and Biotechnology were reviewed and recommended to be forwarded to the Academic Council after incorporation of suggestions by the School Board.
3. BOS of Department of Biotechnology had recommended in meeting held on 19/2/2019:
 - i. Constitution of Board of Examiners for conduct of dissertation viva-voce with one or two external examiners and a panel of faculty of the School.
 - ii. End-term practical examination may be conducted by a panel of internal examiners from the School keeping in view of the operational difficulties of conducting examination by external examiner.

School Board recommends that the above provisions may be implemented in all Departments of the School.

4. School Board recommends to start Summer Training Programme for 1st Year MSc students in all the Departments.

[Handwritten signatures and dates are present at the bottom of the page, including "27/4", "27/4/19", and "27/4/2019".]

Prof. Neelam Sangwan, Member

Dr. Gunjan Goel, Member

Dr. Pawan Maurya, Member

Dr. Kashyap Kumar Dubey, Member

Dr. Meenu Goyal, Member

Dr. Avijit Pramanik, Member

Dr. Sanjay Kumar, Member

Dr. Savita, Member

Prof. J.S. Viridi, External Expert

Prof. Namita Singh, External Expert

Dr. Surender Singh, Special Invitee

Dr. Ashwani Kumar, Special Invitee

Dr. Piyush Kumar, Special Invitee

Prof. Satish Kumar, Dean, SIAL, Chairman

U. Sangwan 27/4/2019

Gunjan Goel 27/4/19

Kashyap Kumar Dubey 27/4

Meenu Goyal 27/4

Avijit Pramanik 27.04.19

Sanjay Kumar

Savita

J.S. Viridi 27/4/2019

Namita Singh 27/4/2019

Surender Singh 27/4/2019

Piyush Kumar 27/4/19

Satish Kumar

Central University of Haryana Jant-Pali, Mahendergarh

Minutes of the Board of Studies of the Department of Nutrition Biology

The following members attended the meeting at Central University of Haryana, Mahendergarh on 14-02-19 at 11:00 A.M.

1. Prof. Satish Kumar, CUH, Mahendergarh, Haryana –Chairperson of the meeting
2. Prof. Asha Kawatra, CCSHAU, Hisar - Member
3. Dr. Savita Budhwar, CUH, Mahendergarh, Haryana –Member
4. Dr. Ashwani Kumar, CUH, Mahendergarh, Haryana –Special Invitee
5. Dr. Tejpal Dhewa, CUH, Mahendergarh, Haryana –Special Invitee

Due to some preoccupation, Dr. Neerja Hajela from Yakult Danone Pvt. Ltd., Sonipat could not attend the meeting.

Agenda No. 1: Finalizing the name of paper setter for the end term examinations of Second and Fourth Semester (2018-19) M.Sc. Nutrition Biology

2. Recommendation of the name of external experts for Departmental Research Committee

3. Revision of the scheme and syllabus of M.Sc. Nutrition Biology

*Agenda No. 1: The Name of the paper setters, for the End Term Examinations of
Second and Fourth Semester (2018-19) M.Sc. Nutrition Biology are recommended
subject wise as under:-*

Semester-II

S. No.	Course No.	Course Title	Proposed name of the paper setters
1	SIAL NB 01 02 05 C4004	Nutritional Biochemistry II	1. Dr. Shyam S. Chauhan Prof. & Head Department of Biochemistry, AIIMS, New Delhi Phone: 26589617; 26594483; 26593272 Email id: s_s_chauhan@hotmail.com 2. Dr. Arjun L. Khandare Scientist-F, National Institute of Nutrition (ICMR), Hyderabad Phone: 9160040377, 4027197325 Email: alkhandare@yahoo.com 3. Dr. Murlikrishna G Chief Scientist, Department of Biochemistry, CSIR-CFTRI, Mysuru Phone: 2514876

			<p>Email: gmk@cetri.res.in</p> <p>4. Dr. Darshan Punia Deptt. Of Food & Nutrition CCSHAU, Hisar Mobile No. 9812092242</p>
2	SIAL NB 01 02 06 C 4004	Biostatistics and Research Methods	<p>1. Prof. Gurprit Grover, Professor Department of Statistics University of Delhi, Delhi-110007 Phone: 9811077432 Email: gurpritgrover@yahoo.com</p> <p>2. Dr. V. Ravi, Associate Professor Department of Statistics, Lady Shri Ram College for Women, University and Delhi, New Delhi-110024 Phone: +91-9868035990 Email: vravi.vr@gmail.com</p> <p>3. Prof. G. P. Singh, Professor Department of Statistics, Banaras Hindu University, Varanasi. Phone: +91-9450014381 Email: singhgpbhu@gmail.com</p> <p>4. Dr. Anup Kumar, Assistant Professor Department of Biostatistics and Health Informatics Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow Phone: 9452196497 Email: anup.stats@gmail.com</p>
3	SIAL NB 01 02 07 C4004	Food Microbiology and Food Safety	<p>1. Dr. S.K. Tomar Principal Scientist, DM, Division, NDRI, Karnal Mob: 9896431072 Email: sudhirndri@gmail.com sudhirtomar@ndri.res.in</p> <p>2. Dr. Shalini Sehgal Associate Professor Department of Food Technology Bhaskaracharya College of Applied Sciences University of Delhi, Sector-2, Phase-I, Dwarka, New Delhi -110075. Mob: 9810586489(M) Email: shalinisehgal72@gmail.com</p> <p>3. Dr Seema Rawat, Associate Professor; School of Life Sciences Central university of Gujarat, Gandhinagar, Gujarat Email: seemamillennium@gmail.com; Mob: 9997765718</p>

			<p>4. Dr. Bhavesh H. Joshi Associate Professor & PG Coordinator Department of Food Quality Assurance , College of Food Processing Technology & Bio-Energy, Anand Agricultural University, Anand – 388 110 Phone: (O): 02692 261 302 (Ex No. 112) Mob: 9099919201 Email: bhavesh@aaui.in</p>
4	<p>SIAL NB 01 02 02 DCEC 5005</p>	<p>Nutraceuticals & Functional Foods</p>	<p>1. Dr. M. K. Tripathi Principal Scientist, Food Biochemistry, CIAE, Bhopal Phone: 9165101340 Email: mktripathi@ciae.res.in</p> <p>2. Dr. Hemalatha R Director National Institute of Nutrition, Hyderabad Phone: +91-40-27197297 Email: rhmalatha@ninindia.org; hemalatha_nin@yahoo.co.in</p> <p>3. Dr. Parmjit S. Panesar Prof., Deptt. of Food Engg. & Technology, SLIET Longowal Mob.: +91-94174-94849 Email: pspbt@yahoo.com</p>
5	<p>SIAL NB 01 02 03 GEC 03003</p>	<p>Bioinformatics (compulsory)</p>	<p>1. Dr. Ashwani Kumar, CUH 2. Dr. Tejpal Dhewa, CUH</p>
6	<p>SIAL NB 01 02 08 C00105</p>	<p>Practical –II: Microbiology and Nutrient Analysis</p>	<p>1. Dr. Ashutosh Professor & Head, Food Science and Technology Department, NIFTEM, Sonapat. Mob.: 9034022694 Email: ashutosh@niftem.ac.in, ashutosh.niftem@gmail.com</p> <p>2. Prof. M. K. Salooja School of Agriculture, IGNOU, New Delhi Mob.: (+) 9891581750 Email: mksalooja@ignou.ac.in</p> <p>3. Dr. Alka Sharma, Department of Food Science & Nutrition, GJU, Hisar Mob.: 9812155510</p>

			<p>4. Dr. Rakesh Kumar Gupta Associate Prof., Microbiology RLA College, University of Delhi Mob.: 9891369197 E-mail : rgupta1965@yahoo.com</p> <p>5. Prof. Salil Seghal Ex Head (Food & Nutrition) H. No.: 1951, Sec-14, Hisar, Haryana Mobile No.: 9215747077</p>
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Semester-IV

S. No.	Course No.	Course Title	Proposed name of the paper setters
1	SIAL NB_01_4_01_ SEEC	Dissertation	<p>1. Dr. A K. Tyagi Principal Scientist & Head, Animal Nutrition, NDRI, Karnal Mob.: 9416950175 Email: amrishtyagi1963@yahoo.com</p> <p>2. Dr. A.K. Puniya Prof. & Dean, College of Dairy Science, GADVASU, Ludhiana. Tel: +91-161-2553308 (off); 2553313 Fax: +91-161-2553313 E-mail: akpuniya@gmail.com deancodst@gadvasu.in</p> <p>3. Dr. Vijendra Mishra Associate Prof. (Microbiology) & DSW, NIFTEM, Sonapat Mob.: 9034016639 Email: vijendramishra@rediffmail.com</p>

Recommendation: Agenda No. 1 is approved.

Agenda No. 2: The names of external experts for Departmental Research Committee are recommended as under:

- I. Dr. S.K. Tomar,
Principal Scientist, Dairy Microbiology Division, NDRI, Karnal
Mob.: 9896431072; Email: sudhirndri@gmail.com; sudhirtomar@ndri.res.in
- II. Dr. Alka Sharma,
Professor, Department of Food Science & Nutrition, GJU, Hisar
Mob.: 9812155510; Email: alkabhardwaj@rediffmail.com
- III. Dr. Vijendra Mishra
Associate Professor (Microbiology), NIFTEM, Sonapat.

Mob.: 9034016639; Email: vijendramishra@rediffmail.com

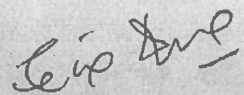
- IV. **Prof. M. K. Salooja**
School of Agriculture, IGNOU, New Delhi
Mob.: (+) 9891581750; Email: mksalooja@ignou.ac.in
- V. **Dr. A. K. Singh,**
Principal Scientist, Dairy Technology Division, NDRI, Karnal
Telephone No.: +91-184-2259291/2259259 (O) Email: aksndri@gmail.com
- VI. **Dr. Prof. Neeraj Dilbagh,**
Professor, Department of Bio & Nano Technology, GJU, Hisar
Tel.: 01662-263500, 01662-263349; Email: ndnano@gmail.com; ndnano@gjust.org
- VII. **Dr. Parmjit S. Panesar**
Prof., Deptt. of Food Engg. & Technology, SLIET Longowal
Mob.: +91-94174-94849; Email: pspbt@yahoo.com
- VIII. **Dr. A.K. Puniya**
Prof. & Dean, College of Dairy Science, GADVASU, Ludhiana.
Tel: +91-161-2553308 (off); 2553313; E-mail: akpuniya@gmail.com;
deancodst@gadvasu.in
- IX. **Dr. Rakesh Kumar Gupta**
Associate Prof., Microbiology, RLA College, University of Delhi
Mob.: 9891369197; E-mail: rgupta1965@yahoo.com
- X. **Dr. A K. Tyagi**
Principal Scientist & Head, Animal Nutrition, NDRI, Karnal
Mob.: 9416950175; Email: amrishtyagi1963@yahoo.com
- XI. **Dr. Baljeet Yadav,**
Associate Prof. & Head, Department of Food Technology, MDU, Rohtak
Mob.: 9896360766; Email: baljeetsingh.y@gmail.com
- XII. **Dr. Rameshwar Singh**
Project Director, Directorate of Knowledge Management in Agriculture (DKMA),
Indian Council of Agricultural Research, 5th Floor, Krishi Anusandhan Bhawan-I,
Pusa, New Delhi 110 012
Tel: (+) 91-11-25842787; E-mail: pddkma@icar.org.in; director.dkma@icar.gov.in
- XIII. **Dr. G.S.Toteja**
Scientist 'G' & Head, Nutrition Division/Unit, ICMR, New Delhi
Tel: 91-11-23731633; Email: gstoteja@gmail.com
- XIV. **Dr. H.P.S. Sachdev**
Sita Ram Bhartia Institute of Science & Research, Delhi
- XV. **Dr. Umesh Kapil,**
Professor, Department of Gastroenterology and Human Nutrition Unit, AIIMS, New Delhi
- XVI. **Dr. Veenu Seth,**
Former Associate Prof, Dept. of Food and Nutrition, Lady Irwin College,
Delhi

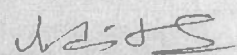
- XVII. Prof. Salil Seghal
Ex Head (Food & Nutrition)
H. No.: 1951, Sec-14, Hisar, Haryana
Mobile No.: 9215747077
- XVIII. Dr. Rajesh Gera
Prof. & Head
Deptt. Of Microbiology
CCSHAU, Hisar, Haryana
Mobile No.: 9416961450
- XIX. Dr. M.K. Garg
Prof. & Head, Food Processing & Engineering
College of Agriculture Engineering & Technology
CCSHAU, Hisar, Haryana
Mobile No.: 9416674060

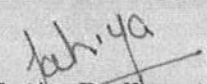
Recommendation: Agenda No. 2 is approved.

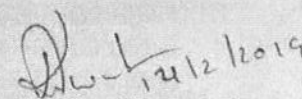
Agenda No. 3: The syllabus of M.Sc. (Nutrition Biology) course (enclosed) is recommended for approval. *subject to the following:*

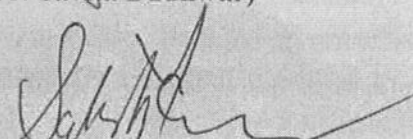
Recommendation: In agenda No. 3, minor changes were suggested. Therefore, the modified version will be sent again through email to the BoS member for final approval.


(Dr. Tejpal Dhewa)


(Dr. Ashwani Kumar)


(Dr. Savita Budhwar)


(Prof. Asha Kawatra)


(Prof. Satish Kumar)



Observation and approval of proceeding of BOS

Neerja <neerja.hajela@yakult.co.in>

Fri, Feb 15, 2019 at 9:49 AM

To: Nutrition Biology <hodnutrition@cuh.ac.in>

Dear Dr. Kumar,

Thank you for sharing the minutes. The same have been approved.

Regards,

Neerja

[Quoted text hidden]

School of Interdisciplinary and Applied Life sciences
Revised Scheme and Syllabi for MSc Nutrition Biology
(2019-2021)



Department of Nutrition Biology
Central University of Haryana
Mahendergarh

Department of Nutrition Biology
Master of Science in Nutrition Biology (Semester-wise Scheme 2019-2021)

Semester-I (Total credits - 24)

Course code	Course title	L	T	P	Type of course	Credit
SIAS SC 1 1 01 C 3003	Cell and Molecular Biology	3	0	0	Core	3
SIAS SC 1 1 02 C 3003	Principles of Biochemistry	3	0	0	Core	3
SIAS SC 1 1 03 C 3003	General Microbiology	3	0	0	Core	3
SIAS SC 1 1 04 C 3003	Genetics	3	0	0	Core	3
SIAS SC 1 1 05 C 3003	Analytical Techniques	3	0	0	Core	3
SIAS SC 1 1 06 C 00105	Practical-I	0	0	10	Core	5
	General Elective Course (to be opted from another Department)	4	0	0	GEC	4

Semester-II (Total credits - 30)

Course code	Course title	L	T	P	Type of course	Credit
SIAS SC 1 2 07 C 4004	Immunology	4	0	0	Core	4
SIAS SC 1 2 08 C 3003	Biosafety, Bioethics and IPR	3	0	0	Core	3
SIAS SC 1 2 09 C 4004	Genomics and Genetic Engineering	4	0	0	Core	4
SIAS NB 1 2 01 C 4004	Human Physiology	4	0	0	Core	4
SIAS NB 1 2 02 C 4004	Nutritional Biochemistry and Metabolomics	4	0	0	Core	4
SIAS NB 1 2 03 C 00105	Practical-II	0	0	10	Core	5
SIAS SC 1 2 10 DCEC 2002	Research Methodology and Scientific Communication Skills*	2	0	0	DCEC	2
SIAS SC 1 2 11 DCEC 2002	Bio-entrepreneurship*	2	0	0	DCEC	2
SIAS NB 1 2 01 DCEC 4004	Nutritional Toxicology [#]	4	0	0	DCEC	4
SIAS NB 1 2 02 DCEC 4004	Functional Foods and Nutraceuticals [#]	4	0	0	DCEC	4
SIAS NB 1 2 03 DCEC 4004	Therapeutic Nutrition [#]	4	0	0	DCEC	4

*One of the courses will be opted by the student.

[#] One of the courses will be opted by the student.

Semester-III (Total credits - 30)

Course code	Course title	L	T	P	Type of Course	Credit
SIAS SC 1 3 12 C 4004	Biostatistics and Bioinformatics	4	0	0	Core	4
SIAS NB 1 3 04 C 4004	Food Microbiology and Food Safety	4	0	0	Core	4
SIAS NB 1 3 05 C 4004	Nutritional Requirements, Deficiency and Assessment	4	0	0	Core	4
SIAS NB 1 3 06 C 4004	Nutrition in Metabolic Disorders	4	0	0	Core	4
SIAS NB 1 3 07 C 0084	Practical-III	0	0	8	Core	4
SIAS NB 1 3 08 C 0202	Seminar	0	2	0	Core	2
SIAS NB 1 3 04 DCEC 4004	Food Biotechnology [#]	4	0	0	DCEC	4
SIAS NB 1 3 05 DCEC 4004	Nutrigenomics [#]	4	0	0	DCEC	4
SIAS NB 1 3 06 DCEC 4004	Sports Nutrition [#]	4	0	0	DCEC	4
	General Elective Course (to be opted from another Department)	4	0	0	GEC	4

[#] One of the courses will be opted by the student.

Semester-IV (Total credits - 20)

Skill Enhancement Course

Course code	Course title	Type of course	Credit
SIAS NB 1 4 01 SEEC 0020	Dissertation	Core	20
Total credits of the Program			104

L- Lecture; T- Tutorial P-Practical; C- Core course; DCEC - Discipline Centric Elective Course --opted by the student; SEEC- Skill Enhancement Elective Course; GEC- General Elective Course

Sahana
13/6/2015

Credit Summary of Courses Offered by Department of Nutrition Biology
(Academic Session 2019-21)

Total Credits: 104

Semester	Credits				Total credits
	Core courses	Skill enhancement course	Elective courses		
			DCEC (For Department of Biotechnology students)	GEC (For other Department students)	
I	20	-	-	4	24
II	24	-	6	-	30
III	22	-	4	4	30
IV	-	20	-	-	20
Total	66	20	10	8	104

Generic Elective Course: Offered by Department of Nutrition Biology to students from other Departments of University.

Semester	Type of course	Course code	Course title	Credit
I	GEC	SIAL NB 1 1 01 GE 4004	Nutrition Immunity	4
		SIAL NB 1 1 02 GE 4004	Work Physiology, Physical Fitness and Health	
III	GEC	SIAL NB 1 3 03 GE 4004	Food Microbiology and Food Safety	4
		SIAL NB 1 3 04 GE 4004	Human Nutritional Requirements	

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SEMESTER-I

Course title: Cell and Molecular Biology
Course code: SIAL SC 1 1 01 C 3003

Credit: 3
Lectures: 45

Course objectives: To understand cellular organization and function at molecular level.

Learning Outcomes:

- Understanding of fundamental concepts of cellular and sub-cellular organization
- Molecular basis of genetic information and function

Unit-I

Archea, prokaryotic and eukaryotic cell (animal and plant cells); Theory of origin of eukaryotic cells; Structure and function of nucleus - nuclear envelope, nuclear pore complex; Nuclear protein-import and export, regulation of nuclear protein import and export; Organization of golgi, lysosome, structure and functions of ER, lysosome, mitochondria, chloroplasts and peroxisomes; Fluid mosaic model, membrane proteins, membrane lipids and membrane fluidity; Transport across cell membrane, passive transport, active transport-primary (P-type, F-type, V-type ATPases, ABC transporters), co-transport-symport and antiport; Ion channels, aquaporins, pinocytosis and phagocytosis; Cells as experimental models.

Unit-II

Introduction to cytoskeletal proteins; Organization of cytoskeletal protein and smooth muscle and skeletal muscles, movement of vesicles-role of actin and myosin; Structure of cilia and flagella; Prokaryotic and eukaryotic cell wall, cell matrix proteins; Cell-matrix interactions and cell-cell interactions; Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata; Signalling molecules, receptors and their functions – G protein coupled receptors- Cyclic-AMP, Cyclic-GMP, IP3, Calcium, Receptor tyrosine kinases - EGF, insulin.

Unit-III

DNA as genetic material, forms of DNA; structure of various type of DNA; chromatin structure; super coiling; polytene and lamp brush chromosomes; properties of DNA in solution; denaturation and renaturation; reassociation reactions; COT curves; types of RNAs and their structures; role of RNA; Unusual bases in RNA; central dogma of molecular biology; DNA polymerases and other enzymes involved in replication; mutagenesis.

Unit-IV

Prokaryotic and eukaryotic gene structure: transcription-RNA polymerase, inhibitors of transcription; proof reading function and fidelity of DNA replication; possible modes of DNA replication; theta model and rolling circle model of DNA replication; replication of DNA in eukaryotes; role of methylation; replication of viral RNA; reverse transcriptase, regulatory region and transcriptional unit of gene; post transcriptional processing of RNA: splicing, cap addition and polyadenylation, polynucleotide phosphorylase.

Suggested readings:

1. The Cell: A Molecular Approach (2018) 8th ed., Cooper, GM, Sinauer Associates is an imprint of Oxford University Press, ISBN: 1605357073.

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2. Molecular Cell Biology (2016) 8th ed., Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D and Darnell J, W.H. Freeman & Company (New York), ISBN: 978-1-4641-0981-2 / ISBN:10: 1464183392.
3. Molecular Biology of the Cell (2008) 6th ed., Alberts B, Johnson A. Lewis J and Enlarge M, Garland Science (Princeton), ISBN: 0-8153-1619-4 / ISBN:0-8153-1620-8.
4. Lehninger Principles of Biochemistry (2017) 7th ed., Nelson DL, Cox MM, W.H. Freeman and Company, New York, USA. ISBN-10: 1-4641-2611-9.
5. Biochemistry (2019) 9th ed., Stryer L, Berg JM, Tymoczko JL, Gatto, Jr. GJ, W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9
6. Genes XII, (2017) 12th Revised edition ed., Lewin B, Krebs J, Kilpatrick ST, Goldstein ES, Jones and Bartlett Publishers, Inc. Sudbury, Massachusetts, USA. ISBN No. 9781284104493.
7. Molecular Biology of the Gene (2013) 7th ed., Watson JD, Baker TA, Bell SP, Gann A, M, Levin RL and Cumming B, San Francisco, ISBN: 0321905377.



SEMESTER-I

Course title: Principles of Biochemistry

Course code: SIAL SC 1 1 02 C 3003

Credit: 3

Lectures: 45

Course objectives: To understand structures and functions of bio-molecules, metabolic pathways in the living systems.

Learning outcomes:

- Comprehensive knowledge of biochemical pathways-synthesis and catabolism of major biomolecules

Unit-I

Monosaccharides-structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers. Disaccharides: maltose, lactose and sucrose. Polysaccharides: homo and hetero-polysaccharides, structural and storage polysaccharides. Glycolysis - a universal pathway, reactions of glycolysis, production of acetyl CoA, reactions of citric acid cycle. Gluconeogenesis, glycogenesis and glycogenolysis.

Unit-II

Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes-phospholipids, glycerophospholipids, galactolipids, sulpholipids, sphingolipids and sterols. β -oxidation of fatty acids. Fatty acid synthase complex. Synthesis of fatty acids.

Unit-III

Amino acids and peptides- classification (essential and non-essential amino acids), chemical reactions and physical properties. Introduction to protein structure and function. Enzymes: classification, kinetics (significance of k_m , k_{cat} and V_{max}), inhibition; amino acid metabolism-amino acid deamination and transamination, urea cycle. Synthesis and utilization of ketone bodies. Biosynthesis and breakdown of nutritionally non-essential amino acids. Synthesis of other amino acid derivatives such as neurotransmitters.

Unit-IV

Nucleotides - structure and properties. Nucleic acid structure-Watson - Crick Model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. De novo synthesis of purine and pyrimidine nucleotides. Catabolism of purine and pyrimidine. Disorders of purine and pyrimidine metabolism.

Suggested readings:

1. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
2. Biochemistry (2017) 6th ed., Garrett RH and Grisham CM, Brooks/Cole, ISBN: 9781305577206.
3. Harper's Illustrated Biochemistry (2018) 7th ed., Rodwell VW, Bender DA, Botham KM, Kennelly, PJ and Weil PA, McGraw-Hill, ISBN: 9781259837937.
4. Lippincott's Illustrated Reviews Biochemistry (2017) 7th ed., Ferrier, Wolters Kluwer India Pvt. Ltd., ISBN: 978-9351297949.
5. Biochemistry (2019) 9th ed., Stryer L, Berg JM, Tymoczko JL, Gatto Jr. GJ, W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9.

SEMESTER-I

Course title: General Microbiology
Course code: SIAL SC 1 1 03 C 3003

Credit: 3
Lecture: 45

Course objective: To provide an understanding of basic concepts and techniques in Microbiology.

Learning outcomes:

- Demonstrate the practical skills in basic microbiological techniques
- Designate the role of microorganisms in different ecosystems
- Retrieve and use contemporary information on different microbial groups

Unit-I

History of development of Microbiology in 20th century; The spontaneous generation controversy; Germ theory of disease; Methods in microbiology: Physical and chemical methods of sterilization; Pure culture techniques, maintenance and preservation of microbial cultures.

Unit-II

Binomial nomenclature; Haeckel's three kingdom classification; Organization of archae, bacteria and eukaryotic cell; Use of DNA and r-RNA sequencing in classification of microorganisms; Woese's three kingdom classification system and its utility - archaea, eubacteria, eukarya; Different groups of acellular microorganisms - viruses, viroids and prions.

Unit-III

General features of microorganisms - bacteria, algae, fungi and protozoa; Bacterial growth and metabolism; Microbes in different environment: extreme environment, deep ocean, space and air. Special features of the thermophilic, methanogenic and halophilic bacteria; Photosynthetic bacteria, Cyanobacteria.

Unit-IV

Scope of Microbiology - Cycle of matter in nature; Microbial interactions – Symbiosis and parasitism; Biodegradation and Bioremediation; Biofilms; Microbes in composting; Biofertilizers and Biopesticides; Microbes and Industry - SCP, microbial enzymes and fermented foods, Vaccines and antibiotics.

Suggested readings:

1. An Introduction to Microbiology (2019), 3rded., Tauro P, Kapoor KK, Yadav KS, and Sequeira MG. New Age International Publishers. ISBN: 0852268785.
2. Brock Biology of Microorganisms (2018) 15thed., Madigan MT, Martinko JM, Bender KS, Buckley DH, Stahl DA Pearson Education, ISBN 9781292235103.
3. Prescott's Microbiology (2017). 10th ed. Sherwood LM, Woolverton C.J McGraw-Hill Education. ISBN 9781259281594.
4. A text book of Microbiology (2013), 3rd ed. Dubey, R.C. and Maheswari, D.K. Revised S. Chand and Company Ltd, New Delhi. ISBN: 9788121926201.
5. Microbiology (2001) 5th ed., Pelczar Jr. M, McGraw Hill Education ISBN: 9780074623206.



SEMESTER-I

Course title: Genetics

Course code: SIAL SC 1 1 04 C 3003

Credit: 3

Lecture: 45

Course objective: To study the fundamental concepts of genetics and its role in unification of different disciplines of biology.

Learning outcomes:

- Understanding of basic concepts of classical genetics and genetic analysis of eukaryotes

Unit-I

Historical background, Principles of Mendelian inheritance, codominance, incomplete dominance, Gene interactions, pleiotropy, Extra chromosomal inheritance: Maternal inheritance (mitochondria and chloroplast), Sex linked inheritance, Sex influenced and Sex limited traits, Gene interactions: Incomplete dominance, codominance, duplicate genes, complementary genes, supplementary genes, lethal genes, pleiotropic genes and multiple alleles.

Unit-II

Linkage: complete and incomplete linkage, linkage analysis and genetic maps, Linkage and recombination of gene, Mechanism of crossing over, Population Genetics and Hardy-Weinberg equilibrium. Genetic analysis: Linkage maps, mapping with molecular markers, Gene mapping by three point test cross, Tetrad analysis, Sex determination and Dosage compensation in Mammals and Drosophila, Quantitative Genetics: Multilocus control; QTL analysis; Quantitative inheritance in plants and human.

Unit-III

Mutations: concept and types, Mechanism of spontaneous mutations, Physical and chemical mutagenesis, Selection and enrichment of mutants, Molecular mechanism of induced mutations, importance of mutation; detection of mutation and directed mutagenesis, Germinal and somatic mutation, insertion, deletion, duplication, translocation, transposition, Numerical alterations of chromosomes: Ploidy and their genetic implications. Types of DNA repair, Molecular mechanism of suppression.

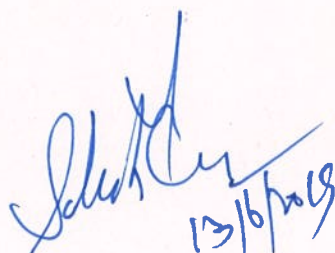
Unit-IV

Nucleosome and chromatin structure, Structure of centromere and telomere, Euchromatin and heterochromatin, Polytene and lamp brush chromosomes, Gene transfer in prokaryotes: Transformation, Conjugation and Transduction, Transposons: types, structures and role in gene regulation, Natural and artificial competence, Operon concept in bacteria and gene regulation, Bacterial plasmids, Lytic and lysogenic cell cycles in Phages.

Suggested readings:

1. Principles of Genetics (2006) 8th ed. Gardner EJ, Simmons, MJ and Snustad DP, John Wiley & Sons Inc, ISBN: 8126510439.
2. Essentials of Genetics (2015) 9th ed. William S, Michael K, Cummings R, Spencer, CA and Palladino MA, Prentice Hall Internationals, ISBN-10: 0134047796
3. Genetics (2017) 9th ed. Daniel L. Hartal & B. Cochrane, ISBN: 128412293X
4. Introduction to Quantitative Genetics (1995) Falconer DS, and Mackay TFC, ISBN: 0582243025.

5. An Introduction to Population Genetics Theory and applications (2013) Nielsen R and Slatkin M, Oxford University Press, ISBN: 1605351539.
6. Evolution 4th ed. (2017) D. Futuma and M. Kirkpatrick, ISBN: 9781605356051
7. An Introduction to Genetic Analysis (2015) Griffith AJFJ, Wessler SR, Carroll SV and Doebley J, ISBN: 0-7167-3520-2.


13/6/2019

SEMESTER-I

Course title: Analytical Techniques
Course code: SIAL SC 1 1 05 C 3003

Credit: 3
Lecture: 45

Course objective: To provide an advanced understanding of the core principles of various techniques used in biological experiments.

Learning outcomes:

- Demonstrate principles of various basic and advanced techniques used in biological experiments
- Critically analyze and interpret the results obtained from biological experiments

Unit-I

Principle of microscopy: resolving powers of different microscopes, magnification; different types of microscopes, principle and applications of compound microscopy, dark microscopy, fluorescence microscopy, phase contrast microscopy, confocal microscopy, atomic force microscopy and electron microscopy (SEM, TEM, STEM); fixation and staining, freeze fracture/etch techniques.

Unit-II

Agarose gel electrophoresis, polyacrylamide gel electrophoresis (native PAGE and SDS-PAGE); Western transfer, iso-electric focusing (IEF), 2-Dimensional gel electrophoresis, pulse field electrophoresis; principle and applications of centrifugation, differential centrifugation, density gradient centrifugation and ultracentrifugation; cell separation by flow cytometry.

Unit-III

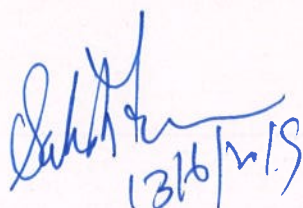
Paper chromatography (ascending and descending, 2-Dimensional); principle and applications of thin layer chromatography (TLC), column chromatography (gel filtration, ion exchange and affinity chromatography); methods of ligand immobilization, immuno-adsorption-hydrophobic interaction chromatography, metal chelate chromatography, covalent chromatography, high performance liquid chromatography (HPLC) and gas liquid chromatography (GLC).

Unit-IV

Principle and instrumentation of UV-visible, infrared spectroscopy, atomic absorption spectrophotometry, NMR spectroscopy, X-ray diffraction spectroscopy, N-terminal sequencing and peptide synthesis, introduction to proteomics, Yeast 2- hybrid and 3-hybrid systems, EMSA, foot printing, phage display, principle of mass spectrometry, electrospray ionization MS, MALDI, tandem MS for protein identification, ICAT-MS.

Suggested readings:

1. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Wilson K and Walker J, Cambridge University Press, ISBN No. 131661476X.
2. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder D, W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.


13/6/2019

SEMESTER – I

Course Title: Practical-I

Course Code: SIAL SC 1 1 06 C 00105

Credit: 5

Lecture: 150

1. Laboratory orientation, calibration, and demonstration of equipment.
2. Solutions, pH and buffers
3. Determination of pKa of acetic acid and glycine
4. Qualitative tests for carbohydrates, lipids, amino acids, and proteins in food samples
5. Metaphase chromosome preparation with G banding and C banding from blood sample
6. RNA *in-situ* hybridization to study gene expression in tissue section
7. Inheritance patterns in man – numerical on pedigree analysis- autosomal patterns, X-linked patterns, Y-linked patterns, mitochondrial inheritance patterns
8. Numerical on Hardy-Weinberg equilibrium
9. Numerical on linkage mapping
10. Different staining methods and microscopic examination of bacteria, actinomycetes, algae, fungi and protozoa
11. Preparation of specific media for isolation of bacteria, and fungi from natural sources
12. Cell counting and cell viability assay
13. Production of microbial enzymes (amylase, phosphatase) and their separation using chromatographic techniques
14. Biochemical characterization of microbial enzymes.
15. Separation of carbohydrates, amino acids and plant pigments using paper/thin layer chromatography
16. Detection of food adulterants
17. Evaluation of microbiological risks in food processing unit through microbiological risk assessment (MRA) tools
18. Assessment of nutritional status of different age group using anthropometric tools

Suggested readings:

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D, Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.
2. An Introduction to Practical Biochemistry (2017) 3rd ed., Plummer, D.T., McGraw Hill Education, ISBN: 978-0070994874.
3. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Wilson K, and Walker J, Cambridge University Press. ISBN: 131661476X.
4. Microbes in Action: A Laboratory Manual of Microbiology (1990) 4th Addition, Harry W, Seeley, Paul JV, John J, W. H. Freeman ISBN: 978-0716721000.
5. Genetics: A Laboratory Manual, (2009) 2nd ed., American Society of Agronomy; Lab Manual edition, ISBN: 978-0891185611.

SEMESTER – I

Course title: Nutrition and Immunity
Course code: SIAL NB 1 1 01 GE 4004

Credit: 4
Lectures: 60

Course objective: To provide knowledge on fundamental concepts of nutrition, immunity and diseases.

Learning outcomes:

- Understanding the relationship between nutrition, immunity and infection
- Comprehensive knowledge about the role of different nutrients in enhancing immunity
- Understanding Relationship between disease and immunity

Unit-I

Terminology related to immunity, introduction to infections and immunity, classification and history, overview of the auto defence mechanisms of the human body, cell and organs related immune system, Phagocytes their role and structure, antigen and antibodies, reaction between antigen and antibody, assessment of the immune response.

Unit-II

Interrelationship between nutrition and immunity. Effect of malnutrition i.e under and over nutrition on immune system. Different macro and micro nutrients and their relationship with immunity. Effect of amino acids on immunity. Antioxidants and immunity. Role of vitamins in immune functions and effect of deficiency, effect of deficiency and excess of vitamins and minerals on immune cell functions, role of micronutrients in improving immunity, effect of infection on the nutritional status, other factors affecting immunity- ageing, obesity, stress, exercise, alcohol, phytochemicals, pre- and probiotics.

Unit-III

Immune system: diseases, disorders and functions, effect of different disease and disorders on the immunity level of persons: allergies, autoimmune diseases, other diseases linked to immune system viz., autoimmune polyglandular syndrome, leukemia, chronic myeloid and ataxia telangiectasia.

Unit-IV

Probiotics and antioxidants – their effect on immune system. Immunity against infection – role of immunization. Maternal & children nutrition - Infections and birth outcomes immunity & infections of infants and children, Impact of breast feeding on immunity of infants, Immunization, prevention of communicable diseases, Relationship of Probiotics, prebiotics with immunity and nutrition.

Suggested readings:

1. Handbook of Nutrition and Immunity (2017) 1st ed., Gershwin ME, Nestel P, Keen CL, Humana Press, DOI: 10.1007/978-1-59259-790-1, ISBN: 9781592597901
2. Nutrition-Infection Interaction and Impact on Human Health (2016) 1st ed., Pammi M, Vallejo JG and Abrams SA, CRC Press, Taylor & Francis Group, ISBN 9781138033764
3. Diet, Immunity and Inflammation (2013) 1st ed., Calder P and Yaqoob P, Woodhead Publishing ISBN: 9780857095749
4. Nutritional Modulation of Immune Function: Analysis of Evidence, Mechanisms, and Clinical Relevance (2019) Wu D, Lewis ED, Pag M and Meydani SN, Front Immunol

- 15;9:3160. doi: 10.3389/fimmu.2018.03160. eCollection 2018. Review. PMID: 30697214
5. Host and Microbe-Dependent Dietary Lipid Metabolism in the Control of Allergy (2019) Saika A, Nagatake T, Kunisawa J. Front Nutr. 10;6:36. doi: 10.3389/fnut.2019.00036. eCollection 2019. Review. PMID: 31024921

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SEMESTER – I

Course title: Work Physiology, Physical Fitness and Health
Course code: SIAL NB 1 1 02 GE 4004

Credit: 4
Lectures: 60

Course objective: To provide an understanding of effect of physical activity on body composition, fitness and health.

Learning outcomes:

- Understanding the concepts & components of health and physical fitness
- Comprehensive knowledge of energy metabolism during exercise or physical activity
- Understanding the importance of maintaining thermoregulation, fluid & electrolyte balance

Unit-I

Definition of health, components of health, holistic health, positive health concept, Physical fitness- definition, components, methods of assessing, role in maintenance of healthy & wellness and types of exercises for fitness training, guidelines for physical activity to maintain health, prevention of obesity and its co-morbidities, techniques to assess physical fitness, Aging theories, physiology, mechanism and role of nutrients in arresting aging process

Unit-II

Body composition, Methods of measuring body composition: direct and indirect. Body composition in different physiological conditions, factors affecting body composition, muscle -structure, muscle classification and types of muscle contraction, major muscles of neck, shoulder, arms, chest, abdominal, back, hip and lower limbs, principles of muscle mechanics, Introduction of weight training, significance and principles of weight training, Do's and Don'ts of weight training

Unit-III

Energy metabolism and physical fitness: concept, importance, influencing factors, Techniques to measure energy expenditure and energy intake, types of energy systems, energy continuum and energy release, cardiovascular response to training and measurement of anaerobic & aerobic capacity, concept of isotonic/isometric/isokinetic exercises, various isotonic, isometric and isokinetic exercises for various muscles of the body, weight training exercises for the women, elderly people and for competitive sports person.

Unit-IV

Exercise and thermo regulatory mechanism, fluid and electrolyte balance, improving physical performance, Ergogenic aids: definition, market, types and effects, exercise and the neuroendocrine system, body composition and fat estimation calculation of kilocalories, harmful effects of quick weight reduction, Scientific approaches of weight reduction.

Suggested readings:

1. Alvero JC, Ronconi M, García JR, Carrillo MD, Jiménez ML, Correias LG, Álvarez EC. (2017) Body composition changes after sport detraining period. *Nutricion hospitalaria*. 34(3):632-8.doi: 10.20960/nh.618.
2. Mazzocchi G. Body composition: Where and when. *European journal of radiology*. 2016 Aug 1;85(8):1456-60.doi: 10.1016/j.ejrad.2015.10.020. Epub 2015 Oct 31
3. *Essentials of Exercise Physiology* (2015) 5th edition, William D. McArdle BS,

M.Ed, PhD, Frank I. Katch EdD, Victor L. Katch EdD, Publisher: Wolters Kluwer, ISBN/ISSN 9781496302090

4. Textbook of Work Physiology: Physiological Bases of Exercise (2003) 4th Edition, Per-Olof Astrand , Kaare Rodahl, Hans A. Dahl , Sigmund B. Stromme. Publisher: Champaign (Ill.) : Human kinetics, 2003 ISBN: 0736001409
5. Nutrition in Exercise and Sport 3nd edition (1997 Ira Wolinsky, CRC Press. ISBN 9780849385605

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SEMESTER-II

Course title: Immunology

Course code: SIAL SC 1 2 07 C 4004

Credit: 4

Lecture: 60

Course objective: To understand overall organization of the immune system and to identify the cellular and molecular basis of immune responsiveness.

Learning outcomes:

- Understanding the working mechanism of the immune system
- Understanding of antibody, MHC, complement system, cytokines, cancer, and organ transplant hypersensitivity

Unit-I

Host-defenses, hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT). Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, chemokines. Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

Unit-II

Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family. Multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification. Antigen independent phase of B cell maturation and selection, humoral response – T-dependent and T-independent response.

Unit-III

Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies. General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, pathways of antigen processing and presentation. Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation. General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

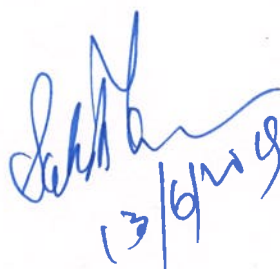
Unit-IV

Mechanism of tolerance, Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity. Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy, Immunohistochemistry, Immunocytochemistry and privileged sites. Vaccines - active and passive immunization, types of vaccines.

Suggested readings:

1. Kuby Immunology (2018) 8th ed., Punt J, Stranford S, Jones P and Owen JA, W.H Freeman and Company, ISBN: 978-1319114701.
2. Janeway's Immunobiology (2017) 9th ed., Murphy KM and Beaver C, WW Norton and Company, ISBN: 978-0815345510.
3. Roitt's Essential Immunology (2017) 13th ed., Delvis PJ, Martin SJ, Burton DR and Roitt, IM, Wiley-Blackwell, ISBN: 978-1118415771.

4. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
5. Lippincott's illustrated Reviews Immunology (2012) 2nd ed., Doan T, Melvold R, Viselli S and Waltenbaugh, C, Wolters Kluwer India Pvt, Ltd, ISBN: 978-8184737639.


13/6/2019

SEMESTER-II

Course title: Biosafety, Bioethics and IPR

Course code: SIAL SC 1 2 08 C 3003

Credit: 3

Lecture:45

Course objective: To introduce the concept of intellectual property rights, patenting and emphasis on biosafety and bioethics.

Learning outcomes:

- Understanding the basics of intellectual property rights
- Understand the importance and level of biosafety at laboratory and industrial levels
- Understand ethical practices and concepts appropriate to the discipline

Unit-I

Biosafety: introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs; principles of safety assessment of transgenic plants – sequential steps in risk assessment; concepts of familiarity and substantial equivalence; risk – environmental risk assessment and food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan; risk assessment of transgenic crops vs cisgenic plants or products derived from RNAi, genome editing tools. Regulations: International regulations-Cartagena protocol, OECD consensus documents and Codex Alimentarius; Indian regulations-EPA act and rules, guidance documents, regulatory framework-RCGM, GEAC, IBSC and other regulatory bodies.

Unit-II

Bioethics: Introduction, ethical conflicts in biological sciences-interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research - cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology-Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity - biopiracy.

Unit-III

Patenting: Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications, PCT and conventional patent applications.

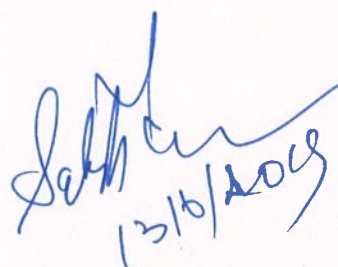
Unit- IV

International patenting-requirement, procedures and costs; financial assistance for patenting, introduction to existing schemes; publication of patents-gazette of India, status in Europe and US; patent infringement- meaning, scope, litigation, case studies and examples

commercialization of patented innovations; licensing-outright sale, licensing, royalty; patenting by research students and scientists-university/organizational rules in India and abroad, collaborative research-backward and forward IP; benefit/Credits sharing among parties/community, commercial (financial) and non-commercial incentives.

Suggested readings:

1. Office of the Controller General of Patents, Design & Trademarks; Department of Industrial Policy & Promotion; Ministry of Commerce & Industry; Government of India. <http://www.ipindia.nic.in/>
2. World Trade Organisation. <http://www.wto.org>
3. World Intellectual Property Organisation. <http://www.wipo.int>
4. International Union for the Protection of New Varieties of Plants. <http://www.upov.int>
5. National Portal of India. <http://www.archive.india.gov.in>
6. IPR, Biosafety and Bioethics (2013) Parashar S, Goel D, Pearson Publishing India, ISBN: 9788131774700.
7. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology (2017) Nambisan P, Academic Press, ISBN: 9780128092316.
8. <http://dbtindia.gov.in/guidelines-biosafety>


13/10/2019

SEMESTER-II

Course title: Genomics and Genetic Engineering

Course code: SIAL SC 1 2 09 C 4004

Credit: 4

Lecture: 60

Course objective: To provide basic and high throughput techniques in the areas of genomics and genetic engineering.

Learning outcomes:

- Understanding of high throughput techniques used in genomics and transcriptomics
- Understand concept of genetic engineering including the techniques, applications and limitations
- Demonstrate the ability of designing recombinant molecules and conducting experiments involving genetic manipulation

Unit-I

Origin of genomics: The first DNA genomes, Structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes, Microbial genomes (including yeast), Plant genomes (Arabidopsis and rice), Animal genomes (fruit fly, mouse, human), Genomes and human evolution, The concept of minimal genome. Genetic maps, Physical maps, EST and transcript maps, Functional maps and Functional genomics, Human genome project-landmarks on chromosomes generated by various mapping method, Comparative genomics and colinearity/syteny in maps, Genetic variation polymorphism, deleterious mutation; FISH to identify chromosome landmarks.

Unit-II

BAC libraries and shotgun libraries preparation (shotgun sequencing); Clone-by-clone or 'hierarchical shotgun' Sequencing, Next Generation sequencing, Genomics in medical practice, personalized medicine, use of SNP in pharmacogenomics, DNA Microarray technology: Basic principles and design, Global gene expression analysis, Comparative transcriptomics, Differential gene expression.

Unit-III

Recombinant DNA Technology: Enzymes used in Recombinant DNA technology (Restriction endonucleases, DNA modifying enzymes, other nucleases, Polymerases, Ligase, kinases and phosphatases), Isolation and purification of DNA (genomic and plasmid) and RNA. Various methods of separation, characterization of nucleic acids including Southern and Northern hybridizations, Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors and their purification.

Unit-IV

Western blotting, generation of genomic and cDNA libraries. plasmid, phage, cosmid, BAC and YAC vectors. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms. Isolation and amplification of specific nucleic acid sequences, PCR, RT-PCR and qRT-PCR, DNA sequencing methods, strategies for genome sequencing. Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques. Site-directed Mutagenesis, protein engineering. Applications of genetic engineering in plants and animal improvements.

Suggested readings:

1. Principles of Gene Manipulation and Genomics (2016) 8th ed., Primrose, SB and Twyman, R, Wiley Blackwell, ISBN: 978-1405156660.
2. Gene Cloning and DNA Analysis: An Introduction (201978-6) 7th ed., Brown, TA, Wiley Blackwell, ISBN: 978-1119072560.
3. Genome 4 (2017) 4th Brown, TA, Garland science, ISBN 13: 978-0815345084.
4. Introduction to Genomics (2015) 2nd ed., Lesk, AM, Oxford university Press India, ISBN: 978-0198745891.
5. Genomics and Personalized Medicine: What Everyone needs to Know (2016) 1st ed., Snyder, M, OUP-USA, ISBN: 978-0190234768.

Signature
13/6/2019

SEMESTER-II

Course title: Human Physiology
Course code: SIAL SC 1 2 01 C 4004

Credit: 4
Lectures: 60

Course objectives: To introduce the physiological concepts of homeostasis and control mechanisms and to study the functions of body systems with emphasis on clinical relevance.

Learning outcomes:

- Understanding of all aspects of general and systemic physiology.
- Understanding of physiological mechanisms of the human body and Pathophysiological processes of diseases.

Unit-I

Cell as the living unit of the body, Homeostasis and Control systems, Transport across cell membranes, Functional systems in the cells, Hematology, Erythropoiesis, Destruction and fate of RBCs, Classification and functions of each type of WBC, Blood Groups, blood disorders- Anemias, Polycythemias, Leucopenia, Leukemias, Thalassemia.

Unit-II

Body fluid compartments, water balance-regulation of fluid balance, Urine formation, Regulation of extra cellular sodium and osmolarity, Renal mechanisms for the control of blood volume, blood pressure and ionic composition and regulation of acid-base balance, Micturition, Diuretics, Renal failure and Kidney function tests.

Unit-III

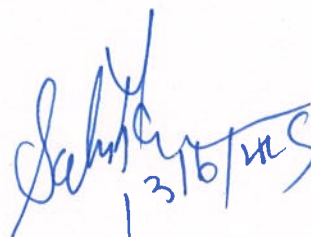
Properties of cardiac muscle and specialized tissues, Cardiac cycle, Cardiac output, Blood pressure (factors & regulation), Cardiac failure, Atherosclerosis, Ischemia, Myocardial Infarction, Hypertension, Gastro-intestinal Physiology, General principles of GI function, Digestion and absorption, Pathophysiology of peptic ulcer and diarrheal disease.

Unit-IV

Classification of hormones and mechanism of hormone action, Endocrine function of the hypothalamus, Pituitary, Thyroid, Adrenals, Endocrine pancreas, Pathophysiology of diabetes, Male and female sex hormones, Hyper and hypogonadism.

Suggested readings:

1. Fox, Stuart Ira, Human Physiology, 14th edition New York, NY, Mcgraw Hill (2016).
2. John E. Hall, Guyton and Hall Textbook of Medical Physiology (Guyton Physiology), 13th edition, Saunders (2015).
3. Gerard J., Tortora and Sandra R. Grabowski. Principles of Anatomy and Physiology, control systems of human body, 10th edition, Wiley and Sons (2003).
4. Anne Waugh and Allison Grant, Ross and Wilson Anatomy and Physiology, 13th edition, Elsevier (2018).
5. Human Physiology, Biochemistry and Basic Medicine by Laurence A. Cole, Peter R. Kramer (2017) Academic Press, Elsevier ISBN 978-0-12-803689-0



SEMESTER-II

Course title: Nutritional Biochemistry and Metabolomics
Course code: SIAL NB 1 2 02 C 4004

Credit: 4
Lectures: 60

Course objectives: To introduce the concepts of basic metabolism of nutrients and their relationships.

Learning outcomes:

- Understanding the properties and role of micro and macronutrients
- Understanding the inter-relationship between carbohydrates, proteins and fats

Unit-I

Carbohydrates: classification, digestion, absorption, transport, utilization and storage. Important metabolic pathways and regulations (glycolysis; tea cycle; electron transport chain and oxidative phosphorylation; glycogen and glycoprotein metabolism); regulation of blood glucose level, inborn errors of carbohydrate metabolism- glycogen storage diseases, lactose intolerance, galactosemia, fructose intolerance.

Unit-II

Lipids: digestion, absorption, deposition and storage. Role of essential fatty acids and lipoproteins, role of omega fatty acids, oxidation of fatty acids and biosynthesis, metabolism of triglycerides, cholesterol: properties, biosynthesis, metabolism and functions, role of liver in lipid metabolism, utilization and synthesis of ketone bodies, lipotropic factors, fatty liver.

Unit-III

Proteins: digestion, absorption, and nitrogen metabolism, protein denaturation, inborn errors of amino acid metabolism- PKU, tyrosinemias, alkaptonuria, albinism, inter-relationship between carbohydrate, fat and protein. Vitamins and Minerals: digestion, absorption, utilization, transport, excretion, factors affecting absorption, deficiency, toxicity, sources.

Unit-IV

Analytical methods: GC, HPLC, Mass spectrometry; NMR, FT-IR; chromatography and electrophoresis; nucleic acid metabolism, metabolomics in nutrition, next-generation nutritional biomarkers, metabolomics resources and analysis: tools, software, libraries, databases, experiment repositories, and meta-data storage.

Suggested readings:

1. Wise S, Phillips. "Evolution of reference materials for the determination of organic nutrients in food and dietary supplements-a critical review." Anal Bioanal Chem. 2019 Jan;411(1):97-127. doi: 10.1007/s00216-018-1473-0. Epub 2018 Dec 1.
2. Lehninger Principles of Biochemistry (2012) 7th ed. Nelson DL and Cox MM, W.H. Freeman & Com. ISBN-13: 978-1-4641-2611-6
3. Harpers Illustrated Biochemistry (2015) 31st ed. Victor WR, David AB, Kathleen MB, Peter JK and Weil PA, Lange, ISBN: 978-1-260-288421
4. Molecular Cell Biology (2013) 4th ed., Lodish H, Berk A, et al, W.H. Freeman and Company, (New York) ISBN: 0-7167-3136-3
5. Shrimanker I, Bhattarai S. Electrolytes. [Updated 2019 May 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Available from: <https://www.ncbi.nlm.nih.gov/books/NBK541123/>
6. Core Concepts in the Disorders of Fluid, Electrolytes and Acid- Base Balance, (2013) Jeff M, Sands MD, David B, Mount MD (auth.), David BM, Mohamed HS, Singh AK (eds.), Springer US., ISBN: 978-1-4614-3769-7, 978-1-4614-3770

SEMESTER-II

Course title: Practical-II

Course code: SIAL NB 1 2 03 C 00105

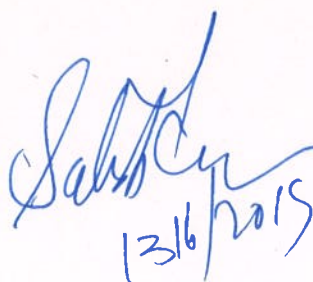
Credit: 5

Lectures: 150

1. Qualitative analysis of sugars.
2. Biochemical examination of body fluid
3. Guidelines and practices related to biosafety
4. Detection of nutritional biomarkers in body fluids
5. Analysis of anti-nutrients in food
6. Extraction and isolation of nutraceuticals
7. Isolation and screening of potential probiotic microorganisms
8. Effect of prebiotics on the growth of selected probiotic microorganisms
9. Dietary assessment methods in epidemiological studies
 - a. Duplicate diet approach
 - b. Food frequency questionnaire
 - c. Food consumption record
 - d. 24-Hour dietary recall
 - e. Dietary record
10. Planning a diet for Cancer, Hepatitis and Arthritis Patients
11. Assessment of Protein quality of Dishes and meals by various indices- NDp Cal% and PDCAAS
12. Diet plan for different age groups.
13. Food exchange list.

Suggested readings:

1. A manual of laboratory techniques. (2003). 2nd edition. Raghuramulu N, Nair MK and Kalyansundaram S, Publisher:Hyderabad : National Institute of Nutrition, ICMR.
2. Qualitative Tests and Quantitative Procedures in Biochemistry : A Practical Manual (2002) Revised ed. Sundararaj P and Siddhu A, Phoenix Publishers ISBN 13: 9788174840622
3. Proteomics of Human Body Fluids: Principles, Methods, and Applications 2007, 1st edition, Visith Thongboonkerd, Publisher: Humana Press, DOI: 10.1007/978-1-59745-432-2, ISBN: 978-1-59745-432-2
4. Shim JS, Oh K, Kim HC. Dietary assessment methods in epidemiologic studies. *Epidemiol Health*. 2014;36:e2014009. Published 2014 Jul 22. doi:10.4178/epih/e2014009


13/6/2015

SEMESTER-II

Course title: Research Methodology and Scientific Communication Skills
Course code: SIAL SC 1 2 10 DCEC 2002

Credit: 2
Lectures: 30

Course objective: To provide knowledge about tools and techniques related with scientific communication and research methodology.

Learning outcomes:

- Understanding the existence of scientific knowledge in ancient times
- Acquiring the skills of scientific reading, writing and presentations
- Appreciating the scientific ethics through case studies

Unit-I

Empirical science; scientific method; manipulative experiments and controls; deductive and inductive reasoning; descriptive science; reductionist vs holistic biology.

Unit-II

Choosing a mentor, lab and research question; maintaining a lab notebook. Concept of effective communication- setting clear goals for communication; determining outcomes and results; initiating communication; avoiding breakdowns while communicating; creating value in conversation; barriers to effective communication; non-verbal communication- interpreting non-verbal cues; importance of body language, power of effective listening; recognizing cultural differences.

Unit-III

Presentation skills - formal presentation skills; preparing and presenting using over-head projector, PowerPoint; defending interrogation; scientific poster preparation & presentation; participating in group discussions; Computing skills for scientific research - web browsing for information search; search engines and their mechanism of searching; hidden Web and its importance in scientific research; internet as a medium of interaction between scientists; effective email strategy using the right tone and conciseness.

Unit-IV

Technical writing skills - types of reports; layout of a formal report; scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts; publishing scientific papers - peer review process and problems, recent developments such as open access and non-blind review; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.

Suggested readings:

1. Research Methodology: Methods And Techniques (2019) 4th ed., Kothari CR and Garg G, New Age International Publishers, ISBN: 978-9386649225.
2. Communicate Science Papers, Presentations, and Posters Effectively (2015) Patience GS, Boffito DC, Patience P, Academic Press, ISBN: 978-0128015001.
3. Successful Scientific Writing: A Step-by-Step Guide for the Biological and Medical Sciences (2014) 4th ed., Matthews JR and Matthews RW, Cambridge University Press ISBN: 978-1107691933.

4. Doing Science: Design, Analysis, and Communication of Scientific Research. (2001) Valiela I, Oxford: Oxford University Press, ISBN 10:019538573X.
5. On Being a Scientist: a Guide to Responsible Conduct in Research. (2009) 3rd ed., Washington DC, National Academies Press.

Sahar
13/6/2015

SEMESTER-II

Course title: Bio-entrepreneurship
Course code: SIAL SC 1 2 11 DCEC 2002

Credit: 2
Lectures: 30

Course objectives: To teach students about concepts of entrepreneurship including identifying a winning business opportunity, gathering funding and launching a business, growing and nurturing the organization and harvesting the rewards.

Learning Outcomes:

- Gain entrepreneurial skills and understand the various operations involved in venture creation
- Identifying scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centres and various agencies

Unit-I

Introduction and scope in Bio-entrepreneurship, Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech), Strategy and operations of bio-sector firms: Factors shaping opportunities. For innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities, Alternatives faced by emerging bio-firms and the relevant tools for strategic decision, Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies.

Unit-II

Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills.

Unit-III

Business plan preparation including statutory and legal requirements, Business feasibility study, financial management issues of procurement of capital and management of costs, Collaborations & partnership, Information technology.

Unit-IV

Technology – assessment, development & upgradation, Managing technology transfer, Quality control & transfer of foreign technologies, Knowledge centers and Technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GCP, GLA, GMP).

Suggested readings:

1. Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge, Routledge Studies in Innovation, Organizations and Technology (2018) 1st ed. Onetti, A, & Zucchella, A, CRC press, Taylor and Francis group. ISBN: 9781138616905.
2. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Shimasaki, CD (2014) Amsterdam: Elsevier. Academic Press is an imprint of Elsevier, ISBN: 0124047300.

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12/11/2018

3. Innovation, Commercialization, and Start-Ups in Life Sciences. (2014) 1st ed. Jordan, JF, CRC Press. Taylor and Francis group, ISBN: 9781482210125.
4. The Dynamics of Entrepreneurial Development and Management. (2011) 6th ed., Desai V, New Delhi: Himalaya Pub. House, ISBN: 9350244543.
5. Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences (2008) Adams, DJ, Sparrow JC, Bloxham, Scion, ISBN:1904842364.

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13/6/2019

SEMESTER-II

Course title: Nutritional Toxicology

Course code: SIAL NB 1 2 01 DCEC 4004

Credit: 4

Lectures: 60

Course objectives: To provide profound knowledge on the basic principles of toxicology and how different toxicants affect human health.

Learning outcomes:

- Identify and describe different sources of toxicity in the food supply
- Describe toxic effects of nutrients eaten in excess of requirements
- Understanding the relationship between nutrient uptake and drug bioavailability

Unit-I

Introduction to basic terms in toxicology, general principles of toxicology, classification of toxicants, mechanisms of toxicants, nature and complexity of food, antinutritional substances in food, overview of methods of toxicity testing (in vivo and in vitro studies), concept of risk analysis, steps involved in risk assessment.

Unit-II

Physical, chemical and biological hazards- types, sources, potential toxic effects of different hazards, naturally present toxicants in foods and their repair mechanism, foodborne illness – causes, prevention, treatment microbial toxins: types, properties, mode of action and toxin inactivation, food allergies and intolerances, food poisoning, types, causative factors, symptoms and prevention, anti-nutritional factors their course of action, harmful effects and their mitigation.

Unit-III

Toxicity of Vitamins, minerals and dietary supplements, Food additives toxicity, Safety Determination of direct and indirect Food Additives, concept of Generally Regarded as Safe (GRAS), Acceptable Daily Intake (ADI), Estimated daily intake (EDI), adverse health effects of different additives, role of Joint FAO/WHO Expert Committee on Food Additives (JECFA) in assessing safety of food additives, Regulatory aspects of additives (FSSAI regulation).

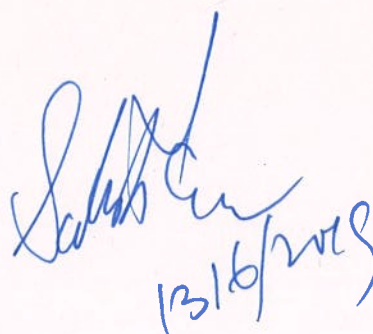
Unit-IV

Disease states/drugs and nutrient deficiency, Food–Drug Interactions: mechanism of action, Interactions of drugs, food, alcohol and nutraceuticals, Strategies for prevention and management. Food packaging material, potential contaminants from food packaging material. Food laws and standards: Farmer Producer Organisation (FPO), ISI, Ag Mark, Codex Alimentarius, ISO, mark for vegetarian and non vegetarian foods, eco-friendly products and others in operation Carcinogens and carcinogenesis, Process-induced toxic compounds; nitrites, nitrates, and nitrosamines, lipid oxidation, Toxic components in foods of marine origin.

Suggested readings:

1. Food toxicology: quantitative analysis of the research field literature. Yeung AWK, Tzvetkov NT, Jóźwik A, Horbanczuk OK, Polgar T, Pieczynska MD, Sampino S, Nicoletti F, Berindan-Neagoe I, Battino M, Atanasov AG. Int J Food Sci Nutr. 2019 May 29;1-9. doi: 10.1080/09637486.2019.1620184. [Epub ahead of print] PMID: 31140340
2. Food and Nutritional Toxicology (2004) 1st ed., Stanley TO, CRC Press, Boca Raton, FLA., ISBN :1587160714, 9781587160714.

3. Food safety: The science of keeping food safe. (2013) Shaw IC Wiley-Blackwell, ISBN: 144433722X.
4. Principles of Food Toxicology (2013) 2nd ed., Püssa T, CRC Press, ISBN: 9781466504103.
5. Nutritional Toxicology Nutrition: Basic and Applied Science Series (2012), Volume 1, Hathcock, J.N. Publisher: Elsevier, ISBN: 0323146937, 9780323146937
6. Food Safety (Point Counterpoint) (2015) 3rd ed., Sherrow V, ISBN, 0791092895, 9780791092897, 978143810612.


13/6/2019

SEMESTER-II

Course title: Functional Foods and Nutraceuticals
Course code: SIAL NB 1 2 02 DCEC 4004

Credit: 4
Lectures: 60

Course objective: To provide enormous knowledge on role of nutraceutical and functional foods in human diet. The course will also provide an understanding of recent advancements in formulation and processing of functional foods.

Learning outcomes:

- Understanding fundamental concepts and knowledge related to functional foods
- Critically evaluation of the mechanism of action and health benefits of different types of nutraceuticals
- Understanding national and international regulations regarding nutraceuticals

Unit-I

Definition and examples of nutraceuticals, functional foods, dietary supplements, fortified foods (scope and relevance), Classification of nutraceuticals, according to source of origin: phyto-nutraceuticals, animal origin, microbial, algal, Nutrient and non-nutrient, Probiotic, prebiotic and synbiotic. Extraction and isolation of nutraceuticals, Perspective for food applications.

Unit-II

Recent advancements in formulation and processing of functional foods, Nanotechnology and functional food. Cellular and molecular mechanisms of action of different types of nutraceuticals relative to their Bioavailability and bio-accessibility, Absorption, disposition, metabolism and elimination of nutraceuticals, Functional foods and nutraceuticals for chronic disease prevention, Adverse effects and toxicity, Gut microbiota, metagenomics.

Unit-III

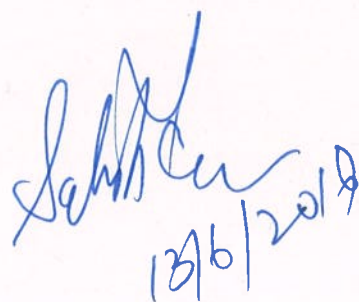
Probiotics: Important features of probiotic micro-organisms, Conventional and non-conventional probiotics; Designer probiotics; Health effects including mechanism of action, use in various foods: fermented milk products, non-milk products etc., Prebiotics: Meaning, Chemical Nature, sources & mechanism of production, metabolism, Importance of Prebiotics in Functional Foods, effects on human health and potential applications in risk reduction of diseases, Perspective for food applications for the following: Non-digestible CHO/Oligosaccharides: Dietary fibre (soluble and insoluble), resistant starch (types and functions), gums; role of short-chain fatty acids; Bio-active proteins and peptides; omega fatty acids in health, Synbiotics: Important features of synbiotics, Health effects including mechanism of action, use in various foods, effects on human health and potential applications in risk reduction of diseases, Perspective for food applications.

UNIT-IV

Important regulatory authorities/bodies and Regulations on functional foods/nutraceuticals: FAO, EFSA and FSSAI; Indian regulations for nutraceuticals/functional foods, Quality assurance of probiotics and safety, ICMR Guidelines on Probiotics, Consumer acceptance –issues for the future. Regulatory compliance, health claims and labelling

Suggested readings:

1. Functional foods and Nutraceuticals (2012), 1st ed., Rotimi EA, Springer Publications. ISBN: 0213657854658.
2. Probiotics: current landscape and future horizons. Day RL, Harper AJ, Woods RM, Davies OG and Heaney LM. Future Sci OA. 2019 May 3;5(4):FSO391. doi: 10.4155/fsoa-2019-0004. Review. PMID: 31114711.
3. Probiotics, prebiotics, and microencapsulation: A review. Sarao LK and Arora M, Crit Rev Food Sci Nutr. 2017 Jan 22;57(2):344-371.
4. Innovation in Healthy and Functional Foods (2016) 1st edition, Ghosh D, Das S, Bagchi D, Smarta RB, CRC Press, London, DOI <https://doi.org/10.1201/b13022> eBook ISBN9780429189401
Nutraceuticals and Functional Food Components (2017), 1st ed., Galankis C, Academic press., ISBN: 9780128052570.
5. Genomics, Proteomics, and Metabolomics in Nutraceuticals and Functional Foods, (2010) Debsis Bagchi, Francis Lau, Manashi Bagchi., Wiley-Blackwell Publishers., ISBN: 0813814022, 9780813814025
6. Functional Foods, Nutraceuticals and Degenerative disease prevention (2011) 1st edi., Gopinadnan P, Bakovic M and Shetty K, Wiley-Blackwell, ISBN: 0812824532, 978081324536, 9780470960844
7. Functional Foods: Concept to Product (2011) 1st edi., Saarela M, Woodhead Publishing., ISBN: 1845696905, 9781845696900
8. Beneficial Microorganisms in Food and Nutraceuticals. (2015) 1st ed., Liong MT, Springer International Publishing Switzerland, ISBN: 3319231766.


13/6/2019

SEMESTER-II

Course title: Therapeutic Nutrition

Course code: SIAL NB 1 2 03 DCEC 4004

Credit: 4

Lectures: 60

Course objective: To provide an understanding of role of therapeutic nutrition for the management of various diseases

Learning outcomes:

- Understanding the principles of meal planning
- Critical assessment of nutritional state and surveillance
- Understanding the role of diet in management of diseases

Unit-I

Introduction to meal management, principles of meal planning, factors affecting meal planning, steps involved in meal planning, food exchange list(s), concept of food exchange list in meal planning, comprehensive food exchange list, diet plan for preschool and school children, adult man, woman and elderly, balanced diet, food groups, planning of balance diet, food guides, diet therapy, diet & stress in current scenario. Food faddism & the faulty food habits, Nutritive value of common Indian foods.

Unit-II

Nutrition in pregnancy - physiological stages of pregnancy, nutritional requirements, complication of pregnancy diet during pregnancy, nutrition during lactation - physiology of lactation, nutritional requirements, nutrition during infancy - growth & development, nutritional requirements, breast feeding, infant formula, introduction of supplementary foods. nutrition during early childhood (toddler/preschool)- growth & nutrient need, nutrition related problems, feeding patterns, nutrition of school children- nutritional requirement, nutrition during adolescence - growth & nutrient needs, food choices, eating habits, nutrition during adulthood - nutritional requirements, geriatric nutrition: factors affecting food intake and nutrient use, nutrient needs, nutrition related problems.

Unit-III

Nutritional problems in emergencies in vulnerable groups, macro and micronutrient deficiencies, infection, nutritional assessment and surveillance. Nutrition care process, nutritional screening and assessment of patients – out patient & hospitalized. Nutrition care plan and implementation. monitoring and follow up, ethical issues, dietary counselling. Nutritional relief and rehabilitation – assessment of food needs, food distribution strategy, mass and supplementary feeding, sanitation and hygiene, evaluation of feeding programs. Nutritional approach to tackle nutrition problems in emergencies. Therapeutic diets (clear fluid, full fluid, soft diet and Regular normal diet), types of hospital diets, diet in different diseases namely cancer, obesity, hypertension, hypotension, hyper and hypothyroidism, peptic ulcer, arthritis and stone patients

Unit-IV

Overview of enteral and parenteral nutrition in Indian context, principles underlying enteral and parenteral feeding, constituents of enteral and parental nutrition formulations, types of enteral and parenteral formulations, access techniques and devices available for enteral and parenteral feeding, formulation of guidelines, ethical issues and legal considerations, complications of enteral feeding overview of diseases, etiology, symptoms and its dietary management of cancer, Alzheimer's disease, Parkinson's disease, HIV-AIDS and Rheumatoid arthritis.

Suggested readings:

1. Nutrition, Gut Microbiota and Immunity: Therapeutic Targets for IBD: 79th Nestlé Nutrition Institute Workshop, New York, N.Y., September 2014 J.D. Lewis, F.M. Ruemmele, G.D. Wu Nestlé Nutrition Institute Workshop Series, Vol. 79, 3318026697, 9783318026696
2. Krause's Food & Nutrition Care Process (2017) 14th edi., L. Kathleen Mahan, MS, RD, CDE and Janice L Raymond, MS, RD, CD, Saunders-Elsevier. ISBN: 9780323340755
3. Food, Nutrition, Physical Activity and the Prevention of Cancer- A Global Perspective. (2007) Washington E.D. WCRF (World Cancer Research Fund & American Institute for Cancer Research) Available from: <http://discovery.ucl.ac.uk/4841/1/4841.pdf>
4. Nutritional Assessment 2013, 6th edition, Robert D. Lee, David C. Nieman, McGraw Hill Higher Education ISBN-13: 9780071326360
5. Integrating Therapeutic and Complementary Nutrition (Modern Nutrition) (2016) Mary JM, Pamela W-M and Jennifer MB, CRC PRESS, Taylor and Francis Group ISBN: 084931612X, 9780849316128, 9781420003413.

Signature
13/6/2023

SEMESTER-III

Course title: Biostatistics and Bioinformatics
Course code: SIAL SC 1 3 12 C 4004

Credit: 4
Lectures: 60

Course objective: To introduce the students in the field of bioinformatics and enables them to understand the concepts of statistics in biology.

Learning outcomes:

- Understanding statistical analysis of biological data
- Understanding the role of computer science in predicting structure and function of biomolecules
- Understanding similarities and differences among living organisms on the basis of genetic information

Unit-I

Definition of selected terms scale of measurements related to statistics; Methods of collecting data, Presentation of data statistical Tables, Need for reduction of data measures of averages and location, Measures of dispersion: Range, quartile deviation, mean deviation and relative deviation. Probability: basic concepts; basic theorems of probability addition and multiplication theorems; conditional probability of Bayes Theorems. Probability mass function, probability density function, cumulative distribution function.

Unit-II

Probability distribution definition and applications; Binominal distribution, Poisson distribution, Normal distribution, logic of statistical standard error estimation testing of hypothesis. Tests of significance: Null hypothesis, alternative hypothesis, type I error, type II error, level of significance, and power of test. Tests for mean based on normal distribution, one sample t-test, two-sample t-test, paired-sample t-test, Chi-Squared test, and Tests for variance based on normal distribution – one sample and two-sample problem. One-way and Two-way analysis of variance (ANOVA) techniques. Correlation concept and applications, Spearman's rank correlation coefficient, regression concept and applications.

Unit-III

Historical background. Scope of bioinformatics - genomics, proteomics, computer aided drug design (structure based and ligand based approaches), Applications of bioinformatics. Introduction to biological databases - primary, secondary and composite databases, Different formats of molecular biology data. NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB)

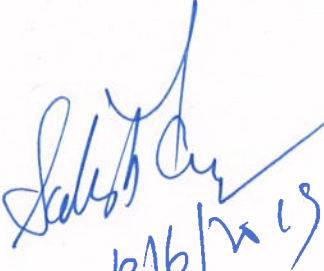
Unit-IV

Similarity, identity and homology. Alignment-local and global alignment, pairwise and multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTAL omega. Identification of open reading frames (ORF), Concept of orthology, paralogy and homology in gene and protein sequences. Methods and tools for phylogenetic analysis, maximum parsimony, maximum likelihood and distance methods; creation, evaluation and interpretation of evolutionary trees phylogenetic tree.

Suggested Readings:

1. Fundamentals of Statistics (2016) Goon, AM, Gupta, MK and Dasgupta, B. Vol. I & II. World Press, ASIN: B01LB7MH74.
2. Statistical Methods (2012) 1st ed., Das, NG. Vol I & II. Tata McGraw Hill, ISBN: 9780070263512.

3. Probability and Statistics for Engineers and Scientists (2013) 9th ed., Walpole, RE, Myers, RH, Myers, SL and Ye, Pearson Education India KE ISBN: 978-9332519084
4. Biostatistics: A Foundation. for Analysis in the Health Sciences (2012) 10th ed., Daniel, WW and Cross, CL. John Wiley & Sons, ISBN: 978-1118302798
5. Essential Bioinformatics (2006) 1st ed., Xiong J, Cambridge University Press, ISBN 13: 978-0521600828.
6. Fundamental concepts of Bioinformatics (2003) Krane DE and Raymer ML Pearson, ISBN: 978-8177587579.
7. An Introduction to Bioinformatics (2017) 1st ed., Knight R, Larsen and Keller Education, ISBN: 978-1635490459.
8. Concepts of Bioinformatics and Genomics (2016) 1st ed., Momand J, McCardy A, Heubah, S and Warter-Perez N, Oxford University Press, ISBN: 978-0199936991


13/6/2019

SEMESTER-III

Course title: Food Microbiology and Food Safety
Course code: SIAL NB 1 3 04 C 4004

Credit: 4
Lectures: 60

Course objective: The major learning objectives of this course will be to study the scope of food microbiology and food safety and to gain the essential knowledge and applications of various techniques (traditional to advanced) for preserving food.

Learning outcomes:

- Understanding techniques (traditional to advanced) for preserving food
- Understanding the role of microorganisms in food spoilage, food fermentation and foodborne diseases
- Understanding microbiological quality control and foodborne illnesses investigation procedures for ensuring food safety and hygiene
- Understanding the requirements and components of food safety management system (FSMS) and practical applications of microbiological risk assessment (MRA) tools for assessing microbiological risks in the food sector

Unit-I

Introduction to food microbiology and food safety; Microflora of food; Intrinsic and extrinsic factors affecting microbial growth and survival in food; Microbiological examination of food; Advances in isolation and enumeration of microorganisms in food; Principles of food preservation and significance; Preservation of food by physical methods – low, high temperatures, radiation; Preservation of food by chemical methods; Bio preservation of food.

Unit-II

Modified environment for storage of food; fermentative microorganisms as food and value-added product, single and mixed fermentation- lactic, yeast-lactic, mold-lactic fermentation in food; starter cultures for food fermentation; fermented milk, milk products, juices, vegetables and other beverages; fermented meat and fish products.

Unit-III

Food spoilage: causes and solutions; spoilage of fruits, vegetables, and their products; spoilage of dairy products, canned food, bakery and egg products, meat, fish, and seafood; newer methods for controlling spoilage of food; predictive modelling for food spoilage; food-borne outbreaks- bacterial agents for food-borne illnesses; fungal and algal agents for food-borne illnesses; food-borne animal parasites.

Unit-IV

Investigation of food-borne illnesses outbreaks; indicators of food microbial quality and safety; principles and applications of hurdle technology in food industry; principles of hygiene and sanitation in food service establishment; food safety laws; food safety and quality management system; principles and guidelines for conducting microbiological risk of food.

Suggested readings:

1. Food Microbiology (2016) 4th edition Adams M R, Moss M O and McClure P, Publisher: Royal Society of Chemistry, ISBN: 9781782627623
2. Food Microbiology (2013) 5th edition Frazier W C and Westhoff D C, Publisher: Mc Graw Hill India, ISBN: 978-1259062513
3. Modern food microbiology (2005), 7th edition, Jay J M, Loessner M J and Golden D A, Publisher: Springer US, DOI: 10.1007/b100840, eBook ISBN 978-0-387-23413-7.

4. Food Microbiology: An Introduction (2017) 4th edition Karl R Matthews K R, Montville T J, Kniel K E, Washington, DC : ASM Press, ISBN: 9781523112579.
5. Prescott's Microbiology (2017) 10th edition, Willey J, Sherwood L and Woolverton J C, Publisher: McGraw Hill Education, ISBN: 9781259281594

Leah C.
12/6/2016

SEMESTER-III

Course title: Nutritional Requirements, Deficiencies and Assessment
Course code: SIAL NB 1 3 05 C 4004

Credit: 4
Lectures: 60

Course objective: To introduce the students in the field of nutrition and enable them to understand about major nutritional deficiency diseases, their assessment and what are the nutritional requirements for different vulnerable group.

Learning outcomes:

- Comprehensive knowledge of methodology and derivation of nutrients requirements
- Acquiring the information about nutritional considerations changes with age and physiological group
- Understanding aetiology and preventive measures for various deficiency diseases
- Gaining knowledge about various methods for improving the quality of diets

Unit-I

Historical perspective of nutrient requirements and definitions (recommended nutrient intakes, minimum requirements, subsistence requirements, dietary reference intakes, optimum nutrient intake. methods of assessment of nutrient needs (factorial approach, balance studies, nutrient turnover, isotope studies, depletion-repletion studies, obligatory loss, enzyme studies)– a critical review. critical evaluation of sensitive methods and derivations of requirements, factors affecting the requirements, recommended dietary allowances of macronutrients for all age groups: energy, carbohydrates and dietary fibre, proteins and amino acids, lipids and fatty acids, water soluble vitamins, fat soluble vitamins, minerals and trace elements, water. food pyramid, indian dietary guidelines.

Unit-II

Aspects of growth- cellular to physical, determinants of growth and development in children, nutritional considerations for adults, pregnant & lactating mothers, infants, preschoolers, school-age children, adolescents, elderly. Impact of altered nutrition on growth and development, maternal malnutrition and pregnancy outcome, malnutrition and cognitive development, body composition changes through the lifecycle and its consequences. Overview of national and international policies related to nutrition, nutrition surveillance and monitoring.

Unit-III

Physiological changes and altered nutritional requirements in extreme temperatures - low and high, high altitude, space nutrition and food systems. Protein energy malnutrition, nutritional anaemia, vitamin A deficiency, iodine deficiency disorders, vitamin D deficiency: aetiology and pathogenesis, clinical manifestations and biochemical changes. Anthropometric measurements – indices and reference standards Biochemical parameters and clinical examination.

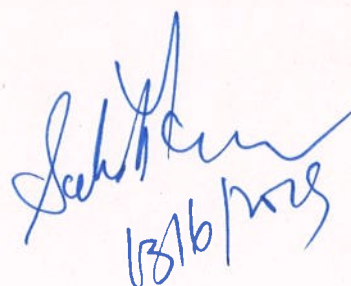
Unit-IV

Ongoing nutrition transition and its implications. Ways of improving nutritional quality of diets. Assessment of protein quality. Dietary diversification. Bioavailability of nutrients. Nutrient losses during cooking and processing. Emerging concepts in human nutrition- Nutrigenomics, nutraceuticals, functional foods and bioactive compounds. National and International agencies in uplifting the nutritional status – World Health Organization (WHO), The United Nations Children's Fund (UNICEF), CARE, Indian council of Medical Research (ICMR), Indian council of Agriculture Research (ICAR), Council of Scientific and Industrial Research (CSIR), Central Food Technological Research Institute (CFTRI). Various nutrition

related welfare programmes, Integrated Child Development Services (ICDS), School Lunch Programme (SLP) and others.

Suggested readings:

1. Aware Food Choices: Bridging the Gap Between Consumer Knowledge About Nutritional Requirements and Nutritional Information [1 ed. 2016]., Angela Tarabella, Barbara Burchi (auth.), Springer Briefs in Food, Health, and Nutrition., Springer International Publishing, ISBN: 978-3-319-23855-5, 978-3-319-23856-2
2. Nutrition: A Lifecycle Approach. (2015) 2nd ed., Chadha R and Mathur P. Orient Blackswan, New Delhi. ISBN-10: 812505930X
3. Nutrient Requirements and Recommended Dietary Allowances for Indians. (2016).ICMR, National Institute of Nutrition, Hyderabad.
4. SHARMA AL. Textbook of Human Nutrition. Med J Armed Forces India. 1998 Jan;54(1):87. doi: 10.1016/S0377-1237(17)30431-8. Epub 2017 Jun 26. PubMed Central PMCID: PMC5531320.
5. Handbook of Nutritional Requirements in a Functional Context - Volume II, Hematopoiesis, Metabolic Function, and Resistance to Physical Stress [First edition] by Rechcigl, Miloslav, CRC Press, ISBN: 978-1-315-89385-3


13/6/2019

SEMESTER-III

Course title: Nutrition in Metabolic Disorders

Course code: SIAL NB 1 3 06 C 4004

Credit: 4

Lectures: 60

Course objective: To understand the concepts of different diseases and role of diet in the management of disease.

Learning outcomes:

- Understanding importance of nutritional assessment in the care of patients
- Understanding metabolic changes in various diseases/disorders and the associated principles of diet therapy
- Comprehend the rationale of prevention of various diseases/disorders

Unit-I

Concept, purpose and principles of diet therapy, basic concepts and methods of - (a) oral feeding (b) tube feeding (c) parental nutrition (d) intravenous feeding, etio-pathophysiology, metabolic and clinical aberrations, diagnosis, complication, treatment, dietary management and recent advances in obesity, overweight and underweight, Diabetes Mellitus – Type 1, Type 2, Diet in Diabetes mellitus: Incidence and predisposing factors, symptoms-types and tests for detection. Metabolism in diabetes dietary treatment & meal management hypoglycaemic agent, insulin and its types. Complication of diabetes.

Unit-II

Diet in surgical conditions and burns. Gout- Nature and occurrence of uric acid, causes, symptoms and diet. Diet in allergy and skin disturbances: Definition, classification, manifestations, common food allergies and dietetic treatment, incidence of Atherosclerosis, dietary principles, hyperlipidaemia, hypertension- causes and dietary treatment, etio-pathophysiology, metabolic and clinical aberrations, diagnosis, complication, treatment, dietary management and recent advances in cardio vascular diseases.

Unit-III

Diet in fever and infections- Types- metabolism in fever, general dietary consideration. Diet in gastritis, peptic ulcer- symptoms, clinical findings, treatment, chemically and mechanically irrigating foods, four stage diet (Liquid, soft, convalescent, liberalized diet). Overview of Nutrition in gastrointestinal disorders, nutrition in diseases of liver, nutrition in food allergy and intolerance.

Unit-IV

Diet in renal diseases: basic renal function, symptoms and dietary treatment in acute and chronic glomerulonephritis, nephrosis, renal failure, dialysis. urinary calculi-causes & treatment. diet in disturbances of small intestine and colon. aetiology, symptoms and dietary treatment in - jaundice, hepatitis, cirrhosis and hepatic encephalopathy. aetiology and dietary management in cancer, effect of cancer therapy on nutritional status, factors affecting carcinogenesis process

Suggested readings:

1. Krause's Food & the Nutrition Care Process, (2017) 14th Edition L. Kathleen Mahan, MS, RD, CDE and Janice L Raymond, MS, RD, CD., Sylvia Escott-Stump., Saunders Elsevier. ISBN: 9780323340755

2. Clinical Nutrition (The Nutrition Society Textbook). (2011). Michael J. Gibney, Marinos Elia, Ljungqvist O and Dowsett J. Blackwell Science., UK ISBN: 0632056266
3. Modern Nutrition in Health and Disease. (2012) 11th ed., Shils ME, Shike M, Ross A.C., Caballero B and Cousins R.J. Lipincott, William and Wilkins. ISBN-10: 1605474614
4. Farrell Metabolic Diseases: Foundations of Clinical Management, Genetics, and Pathology. (2017) 2nd Edition. E. Gilbert-Barness, L.A. Barness, P.M. IOS Press. ISBN: 978-1-61499-717-7
5. Nutrition Management of Inherited Metabolic Diseases: Lessons from Metabolic University. (2015). Laurie E. Bernstein, Fran Rohr, Joanna R. Helm Springer International Publishing. DOI: 10.1007/978-3-319-14621-8 ISBN 978-3-319-14621-8

Signature
13/6/19

SEMESTER-III

Course title: Practical-III

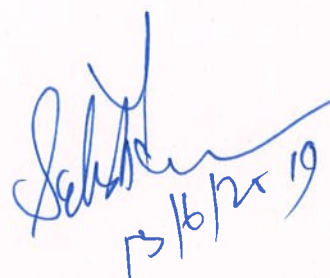
Course code: SIAL NB 1 3 07 C 0084

Credit: 4

1. Isolation and characterization of microorganisms of food origin.
2. Microbiological analysis of water, milk, fruit juices, and street foods.
3. Assessment of Surface sanitation by Swab and Rinse method.
4. Detection of common adulterants in food.
5. Determination of proximate composition of food samples.
6. Determination of mineral contents in the food sample.
7. Assessment of Anthropometry Measurements.
8. Assessment of clinical signs of Nutrient deficiency.
9. Diet plans for Athletes, Wrestler, Badminton Plyer, Cricketer and Chess Player.
10. Diet plan to weight loss and weight gain.
11. Estimation of Serum cholesterol.
12. Planning of Diet
 - a) Fever and infections
 - b) Diabetes mellitus
 - c) CVD's
 - d) Renal diseases
 - e) Gout

Suggested readings:

1. A manual of laboratory techniques. (2003) 2nd edition. Raghuramulu N, Nair MK and Kalyansundaram S (eds). National Institute of Nutrition, ICMR.
2. Cappuccino J G. Microbiology: A Laboratory Manual, 12th edition Pearson (2019)
3. The Microbiology of Safe Food (2010).2nd edition, Forsythe,S.J., Willey-Blackwell,U.K., ISBN: 978-1-405-14005-8
4. The Food Safety Hazard Guidebook, (2012) 2nd edition, Lawley, R., Curtis L. and Davis, J. Royal Society Of Chemistry publishing, Cambridge, United Kingdom ISBN: 101849733813
5. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education limited.



Handwritten signature and date: 13/10/2019

SEMESTER - III

Course title: Seminar

Course code: SIAL NB 1 3 08 C 0202

Credit: 2

Seminar will be of 45-minute duration during which the presentation will be followed by questions session by the audience comprising of faculty and students. Every student shall be required to submit the topic of his/her seminar in consultation with the Head of the Department/Faculty members/student advisors well in advance so that the same may be displayed on the notice board. The presenter has to write an Abstract to be distributed during Seminar in addition to two copies of write-up giving relevant details of the background of the subject, methods used and references/List of sources from where the material for presentation has been collected.

Sahar Singh
13/6/2019

SEMESTER-III

Course title: Food Biotechnology

Course code: SIAL NB 1 3 04 DCEC 4004

Credit: 4

Lectures: 60

Course objective: The major learning objectives of this course will be to develop the understanding of biotechnology applications in relation to food.

- Understand food fermentation for improved nutrition
- Understand novel food additives and supplements
- Understand mechanism and process of food spoilage and its preservation
- Understand monitoring of food quality and packaging of food

Unit-I

Introduction: microorganisms in food-historical developments, food fermentation Technology: origin, scope and development of fermented products, primary feed stock, raw materials and conversions, fermented food and microbial starters, commercial potential, food fermentation industries, their magnitude, R&D innovations.

Unit-II

Development of novel food and food Ingredients: Single cell protein, polysaccharides, low calorie sweeteners, naturally produced flavor modifiers, amino acids, vitamins, food supplements, food coloring, nutraceuticals, water binding agents. Bioreactors in food fermentations: Cultivation of microorganisms, instrumentation regulation and process control, laboratory scale submerged and solid state fermentation, pilot scale submerged and solid state fermentation.

Unit-III

Food spoilage and preservation: general principle of spoilage, microbial toxins (endotoxins and exotoxins), contamination and preservation, factors affecting spoilage. Methods of food preservation (thermal processing, cold preservation, chemical preservatives & food dehydration); Role of radiations in food preservation, characteristics of radiation of interest in food preservation. Principles underlying the destruction of microorganisms by irradiation. Effect of irradiations on food constituents. Legal status of food irradiation.

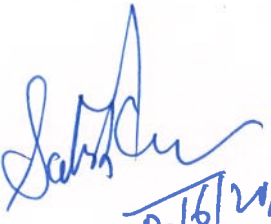
Unit-IV

Biological controls and monitoring of food quality, packaging of food: Need for packaging, requirements for packaging, containers for packaging (glass, metal, plastics, molded pulp and aluminium foil), dispensing devices.

Suggested readings:

1. Introduction to Food Biotechnology., (2002), Perry Johnson-Green. Publisher; CRC Press. USA; ISBN 9780849311529
2. Modern Food Microbiology 7th Ed. (2006)., Jay, James M., Loessner, Martin J., Golden, David A., Springer, ISBN 978-0-387-23413-7
3. Food microbiology: fundamentals and frontiers (2013) 4th edition. Buchanan, Robert, 1946- & Doyle, Michael P & American Society for Microbiology ASM Press, Washington, DC, ISBN: 1555816266

4. Biotechnological Strategies in Agro-processing. (2003)., 2nd ed., Marwaha S.S & Arora, J.K. Asia tech Publishers, New Delhi. ISBN-10: 8187680091
5. Biotechnology in Agriculture and Food Processing: Opportunities and Challenges (2013) 1st edition, Parmjit S. Panesar, Satwinder S. Marwaha., CRC Press ISBN:1439888361, 9781439888360


13/6/2015

SEMESTER-III

Course title: Nutrigenomics

Course code: SIAL NB 1 3 05 DCEC 4004

Credit: 4

Lectures: 60

Course objective: To understand the gene and nutrient interaction.

Learning outcomes:

- Understanding how diet and underlying genetics interaction increase susceptibility to disease.
- Comprehensive knowledge about the methods and strategies used to study complex trait, genetics and nutrition.
- Understanding how nutrients and other bioactive compounds can alter gene expression for improved disease outcome or prevention.
- Understanding how genetic modification of crops can be used to more effectively deliver drugs, vaccines, nutrients and bioactive substances.

Unit-I

Genomics and Applied Bioinformatics (DNA sequencing, DNA Sequence annotation, NCBI resources and other on-line databases, pairwise sequence alignment, blast and advances blast, multiple sequence alignment, evolutionary trees and molecular phylogenetic inference, gene expression), next generation sequencing platforms and role in nutrigenomics, genome sequencing and annotation, variant calling and analysis, clustering and pathways, protein structure, homology modelling.

Unit-II

Nutrient/diet gene interactions, bioactive food components, practical applications. Introduction to macromolecules (carbohydrates, proteins and nucleic acids); animal cells, simple and complex components of organelles, and tissues; important metabolic pathways and regulations (lipids, proteins and nucleic acids).

Unit-III

Introduction to various target validation models (cell-line models, zebrafish model and animal models), control of gene transcription and screening models. Single nucleotide polymorphism and associated metabolic aberrations, epigenetics, nutrigenomics and physiopathology of important non-communicable diseases (obesity, diabetes, cardiovascular diseases); nutrigenomics, genes and gene products which are important in these diseases, personalized nutrition and metabolic diseases. Metabolic effects of the dietary fibre and the modulation of gut microbiota. Body composition and energy assessment.

Unit-IV

Scope of genetic modification in altering nutritional properties and content of bioactive substances in food with details of ongoing research in the field, concept and feasibility of GM therapeutic foods for drug and phytochemical delivery.

Suggested readings:

1. Qi L (2012). Gene-Diet Interactions in Complex Disease: Current Findings and Relevance for Public Health. Current nutrition reports, 1(4), 222–227. doi:10.1007/s13668-012-0029-8
2. Tucker, KL, Smith, CE., Lai, CQ, & Ordovas, JM (2013). Quantifying diet for nutrigenomic studies. Annual review of nutrition, 33, 349–371. doi:10.1146/annurev-nutr-072610-145203.
3. Tanaka, T, Ngwa, J S, van Rooij, FJ, Zillikens, MC, Wojczynski, MK, Frazier-Wood, AC Nettleton, JA (2013). Genome-wide meta-analysis of observational

- studies shows common genetic variants associated with macronutrient intake. The American journal of clinical nutrition, 97(6), 1395–1402. doi:10.3945/ajcn.112.052183
4. Madden J, Williams CM, Calder PC, Lietz G., Miles E. A, Cordell H. Et Al (2011). The Impact of Common Gene Variants on the Response of Biomarkers of Cardiovascular Disease (Cvd) Risk to Increased Fish Oil Fatty Acids Intakes, Annual Review of Nutrition: 31: 203-234.
 5. Institute of Medicine. 2007. Nutrigenomics and Beyond: Informing the Future: Workshop Summary. Washington, DC: The National Academies Press. <https://doi.org/10.17226/11845>.
 6. Kaput, J., & Rodriguez, R. L. (2006). Nutritional Genomics: Discovering the Path to Personalized Nutrition. John Wiley & Sons, Inc. <https://doi.org/10.1002/0471781797>

John Cordell
12/16/2015

SEMESTER-III

Course title: Sports Nutrition

Course code: SIAL NB 1 3 06 DCEC 4004

Credit: 4

Lectures: 60

Course objective: To gain the knowledge and understanding of nutrition required for exercise and sport in order to enhance performance and to learn the role and significance of macro nutrients and micronutrients in achieving fitness.

Learning outcomes:

- Comprehensive knowledge about nutritional guidelines for athletes performing under altered climatic conditions.
- Understanding the importance and process of nutritional counselling for athletes.
- Gaining information about special nutritional concerns of travelling athlete and athletes with physical disabilities.

Unit-I

Nutritional guidelines and nutritional requirements for younger and older athletes, nutritional concerns of travelling and vegan athletes, athletes performing under altered climatic conditions-high altitude mountaineers, high and low climatic temperature, nutrition guidelines for athletes with physical disabilities.

Unit-II

Integrated approach to care for athletes, assessment of sports performance, bioenergetics and body metabolism of physical activity and sports, macro- and micro nutrients for sport performance temperature regulation, fluid balance, fluid requirements of athletes and rehydration strategies for sports.

Unit-III

Recommended allowances and nutritional guidelines for different categories of high-performance sports, nutritional care during training, weight management and day-to-day recovery, nutrition for the pre-competition, competition and post competition recovery phase, supplements in sport: performance enhancing substances, drugs, ergogenic aids and herbs in sports performance.

Unit-IV

Anaemia, osteoporosis, Diabetes Mellitus, hypertension and heart disease (physiology, effect of nutrition, age, sex and exercise on health, preventive and curative strategies), gastro intestinal disorders: peptic ulcer, gastroesophageal reflux disease (GERD), irritable bowel syndrome (IBS), etc., aetiology, pathophysiology and effect of exercise.

Suggested reading:

1. Integrated Periodization in Sports Training & Athletic Development: Combining Training Methodology, Sports Psychology, and Nutrition to Optimize Performance. (2018). 1st edition., Tudor Bompa, Boris Blumstein, James Hoffman. Meyer & Meyer Sport, USA, ISBN: 1782551417
2. Essential Sports Nutrition: A Guide to Optimal Performance for Every Active Person. (2018)., Marni Sumbal. Callisto Media Incorporated. ISBN:1641521694
3. Clinical Sports Nutrition, (2006) 3rd edition Burke, L. Y. and Deaking, V. Tata McGraw HillPub. England. ISBN: 9780074716021
4. Sport Nutrition (2018) 3rd Edition. Jeukendrup, Asker, Gleeson, Michael, Human Kinetics. USA ISBN: 1492529036.

5. Nutritional Ergogenic aids, (2004) 1st Edition Wolinsky, Ira and Driskell, J. CRC Press NY. Management, Belmont (USA). Wadsworth/Thompson Learning. ISBN: 9780849316265

Seaton
12/6/15

SEMESTER – III

Course title: Food Microbiology and Food Safety
Course code: SIAL NB 1 1 03 GE 4004

Credit: 4
Lectures: 60

Course objective: The major learning objectives of this course will be to study the scope of food microbiology and food safety and to gain the essential knowledge and applications of various techniques (traditional to advanced) for preserving food.

Learning outcomes:

- Understanding techniques (traditional to advanced) for preserving food
- Understanding the role of microorganisms in food spoilage, food fermentation and foodborne diseases
- Understanding microbiological quality control and foodborne illnesses investigation procedures for ensuring food safety and hygiene
- Understanding the requirements and components of food safety management system (FSMS) and practical applications of microbiological risk assessment (MRA) tools for assessing microbiological risks in the food sector

Unit-I

Introduction to food microbiology and food safety; microflora of food; intrinsic and extrinsic factors affecting microbial growth and survival in food; microbiological examination of food; advances in isolation and enumeration of microorganisms in food; principles of food preservation and significance; preservation of food by physical methods – low, high temperatures, radiations; preservation of food by chemical methods; bio preservation of food.

Unit-II

Modified environment for storage of food; fermentative microorganisms as food and value-added product, lactic, yeast-lactic, mold-lactic fermentation in food; starter cultures for food fermentation; fermented milk, milk products, juice, vegetables and other beverages; fermented meat and fish products.

Unit-III

Food spoilage: causes and solutions; spoilage of fruits, vegetables, and their products; spoilage of dairy products, canned food, bakery and egg products, meat, fish, and sea food; newer methods for controlling spoilage of food; predictive modelling for food spoilage; foodborne outbreaks- bacterial agents for foodborne illnesses; fungal and algal agents for foodborne illnesses; foodborne animal parasites.

Unit-IV

Investigation of foodborne illnesses outbreaks; indicators of food microbial quality and safety; principles and applications of hurdle technology in food industry; principles of hygiene and sanitation in food service establishment; food safety laws; food safety and quality management system; principles and guidelines for conducting microbiological risk of food.

Suggested readings:

1. Food Microbiology, (2010) 4th edition, Adams M.R. and Moss M.O. New Age Food Microbiology, (2015) 4th edition, Adams M.R. and Moss M.O. New Age International (P) Limited Publishers, New Delhi, India. ISBN:978-1-84973-960-3
2. Food Microbiology. (2008) 4rd edition. Frazier W.C. and Westhoff D.C. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India. ISBN: 9780070667181
3. Modern Food Microbiology, 4th edition, Jay J.M., CBS Publishers and Distributors, Delhi, India, 2009. (Part I) ISBN: 9788123904757

4. Modern food microbiology, (2011) 7th edition, Jay J.M., Loessner M.J. and Golden D.A., CBS Publishers and Distributors, Delhi, India. ISBN 978-0-387-23413-7
5. Microbiology. (2009) 7th edition, M.J., Chan, E.C.S and Krieg, N.R., Tata McGraw-Hill, New Delhi. ISBN: 0-9631172-1-1

Signature
13/11/2015

SEMESTER – III

Course title: Human Nutritional Requirements

Course code: SIAL NB 1 1 04 GE 4004

Credit: 4

Lectures: 60

Course objectives: The aim of this course is to provide knowledge on fundamental concepts nutritional requirements for different age groups and how nutrient requirement changes in different conditions.

Learning outcomes:

- Comprehensive knowledge about nutritional considerations changes with age and physiological group.
- Understanding of body composition changes through the lifecycle.
- Understanding the ways for improving nutritional quality of diets.

Unit -I

Historical perspective of nutrient requirements and definitions (recommended nutrient intakes, minimum requirements, subsistence requirements, dietary reference intakes, optimum nutrient intake), recommended dietary allowances of macronutrients for all age groups, food pyramid, dietary guidelines for indians, guidelines for physical activity (national and international).

Unit-II

Aspects of growth- cellular to physical, determinants of growth and development in children, impact of altered nutrition on growth and development, maternal malnutrition and pregnancy outcome, malnutrition and cognitive development, body composition changes through the lifecycle and its consequences.

Unit-III

Physiological changes and altered nutritional requirements in: Extreme temperatures - low and high, high altitude, space nutrition and food systems and sports nutrition.

Unit-IV

Ongoing nutrition transition and its implications, ways of improving nutritional quality of diets, assessment of protein quality, dietary diversification, bioavailability of nutrients, nutrient losses during cooking and processing, emerging concepts in human nutrition- nutrigenomics, nutraceuticals, functional foods and bioactive compounds.

Suggested readings:

1. Nutrition: A Lifecycle Approach. (2015) 1st Edition., Chadha R and Mathur P., Orient Blackswan, New Delhi. ISBN: 812505930X
2. Nutrient Requirements & Recommended Dietary Allowances for Indians 2nd Edition - (2010) By B.S. Narasinga Rao, B. Sivakumar). ICMR, National Institute of Nutrition, Hyderabad., ASIN: B06XKXGF58
3. Textbook of Human Nutrition. (2009), 3rd Edition. Bamji M.S., Rao N.P., Reddy V. Eds Oxford and IBH publishing Co Pvt Ltd New Delhi, ISBN:81-204-1109-9
4. Nutrition in Developmental Transition. (2006), NFI, NFI-WHO (SEARO) Symposium.?
5. Krause's Food and Nutrition care process. (2017) 14th L. Kathleen Mahan, MS, RD, CDE and Janice L Raymond, MS, RD, CDSt. Louis, Missouri: Elsevier, USA., ISBN:9780323340755

SEMESTER-IV

Course title: Dissertation

Course code: SIAL BT 1 4 01 SEEC 0020

Credit: 20

Guidelines for Project File

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The file is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated goals.
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen that may be useful to document for future reference.
- The guidelines and format for dissertation is given below:

Dissertation Guidelines

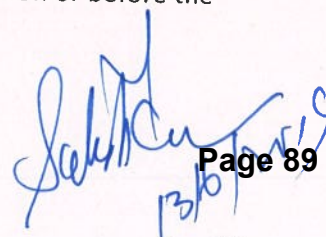
1. GENERAL :

The manual is intended to provide broad guidelines to the M.Sc. candidates in the preparation of the dissertation report. In general, the project report shall report, in an organised and scholarly fashion an account of original research work of the candidate leading to the discovery of new facts or techniques or correlation of facts already known.

2. NUMBER OF COPIES TO BE SUBMITTED:

Students should submit three copies to the Head of the Department concerned on or before the specified date.

3. ARRANGEMENT OF CONTENTS OF DISSERTATION:


Page 89

Dissertation material should be arranged as follows:

1. Cover Page & Title page
2. Declaration
3. Certificate
4. Abstract (Hindi and English)
5. Acknowledgements
6. Table of Contents
7. List of Tables
8. List of Figures
9. List of Symbols, Abbreviations and Nomenclature (Optional)
10. Chapters
11. References
12. Appendices
13. One page CV

The Tables and Figures shall be introduced in the appropriate places.

4. PAGE DIMENSIONS AND MARGIN:

The dimensions of the dissertations should be standard A4 size paper may be used for preparing the copies, **standard margin** with 1.5 line spacing.

5. MANUSCRIPT PREPARATION:

The general text of thesis shall be typed in font style Times New Roman and font size 12. Same quality of paper should be used for the preparation of the entire report/thesis; except figure, photos are shown.

5.1 Cover Page & Title Page - A specimen copy of the Cover page & Title page for report/thesis are given in Annexure I.

5.2 Certificate-The Bonafide Certificate as per the format shown in Annexure II

5.3 Abstract: Abstract should be an essay type (HINDI and ENGLISH) of narration not exceeding 500 words outlining the research problem, the methodology used for tackling it and a summary of the findings, typed in 1.5 line spacing.

5.4 Acknowledgements: The acknowledgements shall be brief and should not exceed one page. The student's signature shall be made at the right bottom above his / her name typed in capitals.

5.5 Table of contents - The table of contents should list all material following it as well as any material which precedes it. The title page, Bonafide Certificate and Acknowledgment will not find a place among the items listed in the Table of Contents but the page numbers in lower case Roman letters are to be accounted for them. One and a half spacing should be adopted for typing the matter under this head. A specimen copy of the Table of Contents for report / thesis is given in Annexure III.

5.6 List of Table - The list should use exactly the same captions as they appear above the tables in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head.

5.7 List of Figures - The list should use exactly the same captions as they appear below the figures in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head

5.8 List of Symbols, Abbreviations and Nomenclature - One and a half spacing should be adopted for typing the matter under this head. Standard symbols, abbreviations etc. should be used.

5.9 Chapters - The chapters may include

Chapter I – Introduction

Chapter II - Literature Review

Chapter III –Materials and Methods

Chapter IV- Results and Discussion

5.10 Research output/outcome if any published or presented in conference/seminar/symposium may be included.

5.11 List of References - Any works of other researchers, if used either directly or indirectly, should be indicated at appropriate places in the report/thesis. The citation may assume any one of the following forms. **APA Style.**

APA in-text citation style uses the author's last name and the year of publication, for example: (Field, 2005).

Example:

Derwing, T. M., Rossiter, M. J., & Munro, M. J. (2002). Teaching native speakers to listen to foreign-accented speech. *Journal of Multilingual and Multicultural Development*, 23(4), 245-259.

Thomas, H. K. (2004). *Training strategies for improving listeners' comprehension of foreign-accented speech* (Doctoral dissertation). University of Colorado, Boulder.

6. TYPING INSTRUCTIONS

6.1 General

This section includes additional information for final typing of the thesis. Some information given earlier under 'Manuscript preparation' shall also be referred. The impressions on the typed/duplicated/printed copies should be black in colour. Corrections, interlineations and crossing out of letters or words will not be permitted in any of the copies of the report/thesis intended for submission. Erasures, if made, should be neatly carried out in all copies. A sub-heading at the bottom of a page must have at least two full lines below it or else it should be carried over to the next page. The last word of any page should not be split using a hyphen. One and a half spacing should be used for typing the general text. The general text shall be typed in Font Style Times New Roman and Font Size 12.

Single spacing should be used for typing:

- (i) Long Tables
- (ii) Long quotations
- (iii) Foot notes
- (iv) Multilane captions
- (v) References

6.2 Chapters The format for typing chapter headings, division headings and sub division headings shall be same as given in Table of Contents.

7. BINDING SPECIFICATIONS

Thesis should be spiral or soft cover book bound, the cover of thesis should be of dark green color, printed with golden ink and the text for printing should be identical as prescribed for the title page.

APPENDIX I A:(A typical Specimen of Cover Page & Title Page–DISSERTATION REPORT)

TITLE OF DISSERTATION REPORT

<1.5 line spacing>



DISSERTATION

Submitted by

<Italic>

NAME OF THE CANDIDATE

Under the Supervision of

NAME OF THE SUPERVISOR

in partial fulfillment for the award of the degree of

<1.5 line spacing>

MASTERS OF SCIENCE IN

NAME OF THE PROGRAMME

DEPARTMENT OF

SCHOOL OF

CENTRAL UNIVERSITY OF HARYANA,

MAHENDERGARH-HARYANA

<1.5 line spacing>

MONTH AND YEAR

Sahdev
13/6/2015
Page 92

DECLARATION

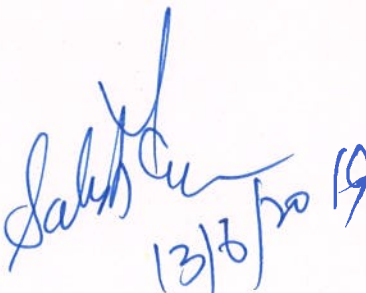
I, student of the School of Interdisciplinary and Life Sciences, Central University of Haryana, Mahendergarh hereby declare and certify with my signature that my thesis entitled

..... submitted to the Department of, Central University of Haryana, India in partial fulfillment of the requirements for the award of the Degree of Masters of Science is a record of original research work done by me and the dissertation has not been the basis for the award of any degree/diploma/associateship/fellowship or similar title of any candidate of any University. I have faithfully and accurately cited all my sources, including books, journals, handouts and unpublished manuscripts, as well as any other media, such as the Internet, letters or significant personal communications.

I understand the concept of "plagiarism" and declare that while drafting this dissertation I have refrained from plagiarism. I know that plagiarism not only includes direct copying, but also the extensive use of other's ideas without proper referencing or acknowledgement (which includes the proper use of references and quotation marks).

If my dissertation found to be plagiarized at any point of time, I'll be solely responsible and will be ready to accept any decision taken by the competent authority including rejection of my dissertation.

(Signature of student)


13/8/2019

APPENDIX – I B: (A typical Specimen of Certificate)

Font Style <Times New Roman >

CENTRAL UNIVERSITY OF HARYANA

CERTIFICATE

This is to certify that the dissertation entitled “**TITLE OF THE DISSERTATION**”, submitted to the Department of, Central University of Haryana, India in partial fulfillment of the requirements for the award of the Degree of Masters of Science in is a record of original research work done by **NAME OF THE CANDIDATE (Roll No.....)**. in the..... (Place of research) under my guidance. It is further certified that to the best of our knowledge the dissertation has not been the basis for the award of any degree/diploma/associateship/fellowship or similar title of any candidate of any University so far.

<<Signature of the Supervisor with date>>

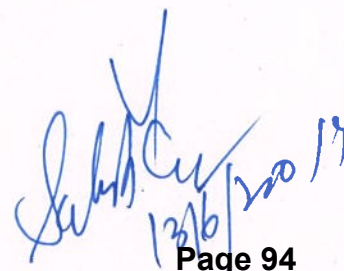
<<Name of the Supervisor >>

<<Academic Designation of Supervisor>>

<<Name of Division/Centre>>

Central University of Haryana

Mahendergarh-123031



Page 94

For example

(A typical Specimen of Table of Contents)

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	iii
	LIST OF TABLES	xvi
	LIST OF FIGURES	xviii
	LIST OF SYMBOLS, ABBREVIATIONS	xxvii
1	INTRODUCTION	1
	1.1 GENERAL	1
	1.2 NEED FOR THE STUDY	2
	1.3 OBJECTIVES OF THE STUDY	3
2	REVIEW OF LITERATURE	4
	2.1 INTRODUCTION	4
	2.2	4
	2.2.1 Product	6
	2.2.2 Product....	6

Sahib Singh
13/6/2019

ANNEXURE II

Curriculum vitae

Personal Details

Name :

Date of birth : DD Month, YYYY

Place of birth :

Nationality : Indian

Permanent Address :

Email Id :

Mobile No. :

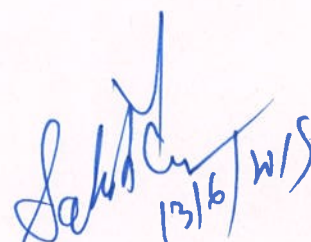
Education

M.Sc. (Subject) : YYYY Central University of Haryana, India

B.Sc. (Subject). : YYYY (Name of the University) with % of marks

Higher Secondary : YYYY (Name of the board) with % of marks

Secondary : YYYY, (Name of the board) with % of marks

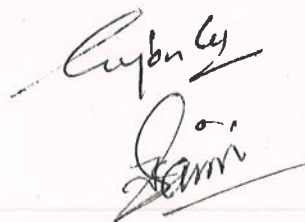

13/6/2015

BoS Recommendations: MICROBIOLOGY **Annexure-III**

**Department of Microbiology
Central University of Haryana**

The BOS members Prof. J. S. Virdi and Prof. Kamla Chaudhary approved the proposed revision in scheme and syllabus after incorporation of the suggested revision on the first week of March, 2019.

The faculty members of the department have been informed about their approvals and recommendations and this was forwarded for consideration in School Board.





New Course scheme and Syllabus

Kamla Chaudhary <chaudharykamla@gmail.com>
To: Microbiology Department <hodmicrobiology@cuh.ac.in>

Sun, Mar 3, 2019 at 6:23 PM

Dear Dr. Goel

Approved as proposed with modifications.

No. of reference books should not be more than five or so....

A few e-books should be included.

Uniform format for References.

KC

On Sat, Feb 23, 2019, 09:32 Microbiology Department <hodmicrobiology@cuh.ac.in> wrote:
Dear Sir and Mam

Please find attached herewith the detailed scheme and syllabi for the M.Sc. Microbiology course for the coming semester of 2019-2021. As a BOS member, you are requested to please review and suggest modifications. As stated before, I have highlighted the courses which are common in all the departments of life sciences.

Looking forward for your recommendations, please.

With regards

Gunjan

Gunjan Goel, PhD
Head and Associate Professor
Department of Microbiology
School of Interdisciplinary and Applied Sciences (SIAL)
Central university of Haryana
Mahendergarh, Haryana
Phone: 9882125930
Email: hodmicrobiology@cuh.ac.in
web: www.cuh.ac.in



New Course scheme and Syllabus

Virdi JS <virdi_dusc@rediffmail.com>

Wed, Mar 6, 2019 at 8:00 AM

To: Microbiology Department <hodmicrobiology@cuh.ac.in>, chaudharykamla
<chaudharykamla@gmail.com>

Dear Dr. Gunjan Goel

I have carefully gone through the syllabus sent by you.

I have also looked at carefully the changes/improvements mentioned by you. However some of the suggestions are:

1. A Virology paper is required. Though virology is part of Microbial Diversity paper, you may name it Virology, Mycology and Phycology.
2. The recommended texts for further reading should be the latest editions. Currently most books mentioned are almost 10 years or more older.

Best regards.

(j.s.virdi)

J. S. Virdi, Formerly Prof., Department of Microbiology, University of Delhi South Campus, Benito Juarez Marg, New Delhi-110 021, India. virdi_dusc@rediffmail.com / virdi.dusc@gmail.com; Mobile 98187 67164

2019: Deptt. Website (<http://microbio.du.ac.in/web3/index.php?page=faculty-profiles>)

2019: President, Association of Microbiologists of India (AMI) (http://amiindia.info/office_bearer.php)

2016: Discovery Award, UK (<https://longitudeprize.org/teams/university-delhi-south-campus-amr-team>)

2016: Lab Mentor Award, US (https://drive.google.com/file/d/0B54__Hd4jW2dLXhCSEVkeHVvOWs/view)

2015: BIRAC AMR Idea-thon Prize, India (<https://www.facebook.com/jugsharan.virdi>)

2006: ICMR Award, India (<https://twitter.com/JugsharanVirdi>)

From: Microbiology Department <hodmicrobiology@cuh.ac.in>

Sent: Tue, 05 Mar 2019 09:23:12

To: Virdi JS <virdi_dusc@rediffmail.com>, virdi_dusc@south.du.ac.in

Subject: Re: New Course scheme and Syllabus

Dear Sir

As discussed, following are the changes made in scheme and syllabi

- 1) The 1st semester courses are common to all branches of life sciences (Courses include: Cell biology, Analytical Techniques, Genetics, Molecular Biology, Principles of Biochemistry and General Microbiology)
- 2) Inclusion of a course on IPR, Bioethics and Bioentrepreneurship in Semester-II
- 3) Revised syllabi of Immunology in Semester-II
- 4) Inclusion of course on Microbial diversity (in place of Bacteriology, Phycology & Mycology and Virology as separate individual courses) in Semester-II
- 5) Inclusion of course on Biostatistics and Bioinformatics in Semester-III
- 6) Inclusion of one new Department centric elective course on Microbial Ecology in Semester-III
- 7) Revised Syllabus of Medical and Veterinary Microbiology in Semester-III
- 8) Introduction of four new General Elective courses (for other departments) on Biofertilizer & compost Technology, Techniques in Microbiology, Applied Microbiology and Microbes & Diseases.
- 9) Minor revisions in syllabi of other ongoing courses.

Looking forward for your recommendations on the changes

With regards

School of Interdisciplinary and Applied Life sciences

**Revised Scheme and Syllabi for MSc Microbiology
(2019-2021)**



**Department of Microbiology
Central University of Haryana
Mahendergarh**

Department of Microbiology
Master of Science in Microbiology (Semester wise structure 2019-2021)

Semester-I (Total credits - 24)

Course code	Course title	L	T	P	Type of course	Credit
SIAL SC 1 1 01 C 3003	Cell and Molecular Biology	3	0	0	Core	3
SIAL SC 1 1 02 C 3003	Principles of Biochemistry	3	0	0	Core	3
SIAL SC 1 1 03 C 3003	General Microbiology	3	0	0	Core	3
SIAL SC 1 1 04 C 3003	Genetics	3	0	0	Core	3
SIAL SC 1 1 05 C 3003	Analytical Techniques	3	0	0	Core	3
SIAL SC 1 1 06 C 00105	Practical-I	0	0	10	Core	5
	General Elective Course (to be opted from other Department)	4	0	0	GEC	4

Semester-II (Total credits - 30)

Course code	Course title	L	T	P	Type of course	Credit
SIAL SC 1 2 07 C 4004	Immunology	4	0	0	Core	4
SIAL SC 1 2 08 C 3003	Biosafety, Bioethics and IPR	3	0	0	Core	3
SIAL MB 1 2 01 C 4004	Microbial Diversity	4	0	0	Core	4
SIAL MB 1 2 02 C 4004	Microbial Physiology and Metabolism	4	0	0	Core	4
SIAL MB 1 2 03 C 4004	Soil and Agriculture Microbiology	4	0	0	Core	4
SIAL MB 1 2 04 C 00105	Practical-II	0	0	10	Core	5
SIAL SC 1 2 10 DCEC 2002	Research Methodology and Scientific Communication Skills*	2	0	0	DCEC	2
SIAL SC 1 2 11 DCEC 2002	Bio-entrepreneurship*	2	0	0	DCEC	2
SIAL MB 1 2 01 DCEC 4004	Food and Dairy Microbiology [#]	4	0	0	DCEC	4
SIAL MB 1 2 02 DCEC 4004	Environmental Microbiology [#]	4	0	0	DCEC	4

*One of the courses will be opted by the student.

[#] One of the courses will be opted by the student.

Semester-III (Total credits - 30)

Course Code	Course Title	L	T	P	Type of Course	Credit
SIAL SC 1 3 12 C 4004	Biostatistics and Bioinformatics	4	0	0	Core	4
SIAL MB 1 3 05 C 4004	Microbial Genetics and Genomics	4	0	0	Core	4
SIAL MB 1 3 06 C 4004	Industrial Microbiology	4	0	0	Core	4
SIAL MB 1 3 07 C 4004	Medical Microbiology and Virology	4	0	0	Core	4
SIAL MB 1 3 08 C 0084	Practical-III	0	0	8	Core	4
SIAL MB 1 3 09 C 0202	Seminar	0	2	0	Core	2
SIAL MB 1 3 03 DCEC 4004	Microbial Ecology [#]	4	0	0	DCEC	4
SIAL MB 1 3 04 DCEC 4004	Plant Pathology [#]	4	0	0	DCEC	4
	General Elective Course (to be opted from other Department)	4	0	0	GEC	4

[#]One of the courses will be opted by the student.

Semester-IV (Total credits - 20)

Skill Enhancement Course

Course Code	Course Title	Type of Course	Credit
SIAL MB 1 4 01 SEEC 0020	Dissertation	Core	20
Total credits of the Program			104

L- Lecture; T- Tutorial P-Practical; C- Core course; DCEC - Discipline Centric Elective Course - to be opted by the student; SEEC- Skill Enhancement Elective Course; GEC- General Elective Course.

Sahithi
12/6/2019

Supan

Credit Summary of Courses Offered by Department of Microbiology
(Academic Session 2019-21)

Total Credits: 104

Semester	Credits				Total credits
	Core courses	Skill enhancement course	Elective courses		
			DCEC (For Department of Microbiology students)	GEC (For other Department students)	
I	20	-	-	4	24
II	24	-	6	-	30
III	22	-	4	4	30
IV	-	20	-	-	20
Total	66	20	10	8	104

Generic Elective Course (GEC): Offered by Department of Microbiology to students from other Departments of University.

Semester	Core/ Elective	Paper Code	Title of the Paper	Credit
I	GEC	SIAL MB 1 1 01 GEC 4004	Biofertilizer and Compost Technology	4
	GEC	SIAL MB 1 1 02 GEC 4004	Techniques in Microbiology	
III	GEC	SIAL MB 1 3 03 GEC 4004	Applied Microbiology	4
	GEC	SIAL MB 1 3 04 GEC 4004	Microbes and Diseases	

Sahana
12/6/2019

Supan G

SEMESTER-I

Course title: Cell and Molecular Biology

Course code: SIAL SC 1 1 01 C 3003

Credit: 3

Lectures: 45

Course objectives: To understand cellular organization and function at molecular level.

Learning Outcomes:

- Understanding of fundamental concepts of cellular and sub-cellular organization
- Molecular basis of genetic information and function

Unit-I

Archea, prokaryotic and eukaryotic cell (animal and plant cells); Theory of origin of eukaryotic cells; Structure and function of nucleus - nuclear envelope, nuclear pore complex; Nuclear protein-import and export, regulation of nuclear protein import and export; Organization of golgi, lysosome, structure and functions of ER, lysosome, mitochondria, chloroplasts and peroxisomes; Fluid mosaic model, membrane proteins, membrane lipids and membrane fluidity; Transport across cell membrane, passive transport, active transport-primary (P-type, F-type, V-type ATPases, ABC transporters), co-transport-symport and antiport; Ion channels, aquaporins, pinocytosis and phagocytosis; Cells as experimental models.

Unit-II

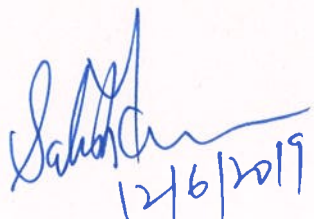
Introduction to cytoskeletal proteins; Organization of cytoskeletal protein and smooth muscle and skeletal muscles, movement of vesicles-role of actin and myosin; Structure of cilia and flagella; Prokaryotic and eukaryotic cell wall, cell matrix proteins; Cell-matrix interactions and cell-cell interactions; Adherence junctions, tight junctions, gap junctions, desmosomes, hemi-desmosomes, focal adhesions and plasmodesmata; Signalling molecules, receptors and their functions – G protein coupled receptors- Cyclic-AMP, Cyclic-GMP, IP3, Calcium, Receptor tyrosine kinases - EGF, insulin.

Unit-III

DNA as genetic material, forms of DNA; structure of various type of DNA; chromatin structure; super coiling; polytene and lamp brush chromosomes; properties of DNA in solution; denaturation and renaturation; reassociation reactions; COT curves; types of RNAs and their structures; role of RNA; Unusual bases in RNA; central dogma of molecular biology; DNA polymerases and other enzymes involved in replication; mutagenesis.

Unit-IV

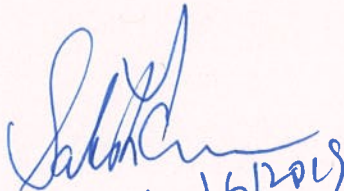
Prokaryotic and eukaryotic gene structure: transcription-RNA polymerase, inhibitors of transcription; proof reading function and fidelity of DNA replication; possible modes of DNA replication; theta model and rolling circle model of DNA replication; replication of DNA in eukaryotes; role of methylation; replication of viral RNA; reverse transcriptase, regulatory region and transcriptional unit of gene; post transcriptional processing of RNA: splicing, cap addition and polyadenylation, polynucleotide phosphorylase.


12/6/2019



Suggested readings:

1. The Cell: A Molecular Approach (2018) 8th ed., Cooper, GM, Sinauer Associates is an imprint of Oxford University Press, ISBN: 1605357073.
2. Molecular Cell Biology (2016) 8th ed., Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D and Darnell J, W.H. Freeman & Company (New York), ISBN: 978-1-4641-0981-2 / ISBN:10: 1464183392.
3. Molecular Biology of the Cell (2008) 6th ed., Alberts B, Johnson A, Lewis J and Enlarge M, Garland Science (Princeton), ISBN: 0-8153-1619-4 / ISBN:0-8153-1620-8.
4. Lehninger Principles of Biochemistry (2017) 7th ed., Nelson DL, Cox MM, W.H. Freeman and Company, New York, USA. ISBN-10: 1-4641-2611-9.
5. Biochemistry (2019) 9th ed., Stryer L, Berg JM, Tymoczko JL, Gatto, Jr. GJ, W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9
6. Genes XII, (2017) 12th Revised edition ed., Lewin B, Krebs J, Kilpatrick ST, Goldstein ES, Jones and Bartlett Publishers, Inc. Sudbury, Massachusetts, USA. ISBN No. 9781284104493.
7. Molecular Biology of the Gene (2013) 7th ed., Watson JD, Baker TA, Bell SP, Gann A, M, Levin RL and Cumming B, San Francisco, ISBN: 0321905377.


12/6/2019



SEMESTER-I

Course title: Principles of Biochemistry
Course code: SIAL SC 1 1 02 C 3003

Credit: 3
Lectures: 45

Course objectives: To understand structures and functions of bio-molecules, metabolic pathways in the living systems.

Learning outcomes:

- Comprehensive knowledge of biochemical pathways-synthesis and catabolism of major biomolecules

Unit-I

Monosaccharides-structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers. Disaccharides: maltose, lactose and sucrose. Polysaccharides: homo and hetero-polysaccharides, structural and storage polysaccharides. Glycolysis - a universal pathway, reactions of glycolysis, production of acetyl CoA, reactions of citric acid cycle. Gluconeogenesis, glycogenesis and glycogenolysis.

Unit-II

Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes-phospholipids, glycerophospholipids, galactolipids, sulpholipids, sphingolipids and sterols. β -oxidation of fatty acids. Fatty acid synthase complex. Synthesis of fatty acids.

Unit-III

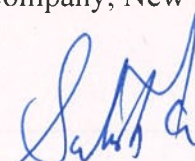
Amino acids and peptides- classification (essential and non-essential amino acids), chemical reactions and physical properties. Introduction to protein structure and function. Enzymes: classification, kinetics (significance of k_m , k_{cat} and V_{max}), inhibition; amino acid metabolism-amino acid deamination and transamination, urea cycle. Synthesis and utilization of ketone bodies. Biosynthesis and breakdown of nutritionally non-essential amino acids. Synthesis of other amino acid derivatives such as neurotransmitters.

Unit-IV

Nucleotides - structure and properties. Nucleic acid structure-Watson - Crick Model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. De novo synthesis of purine and pyrimidine nucleotides. Catabolism of purine and pyrimidine. Disorders of purine and pyrimidine metabolism.

Suggested readings:

1. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
2. Biochemistry (2017) 6th ed., Garrett RH and Grisham CM, Brooks/Cole, ISBN: 9781305577206.
3. Harper's Illustrated Biochemistry (2018) 7th ed., Rodwell VW, Bender DA, Botham KM, Kennelly, PJ and Weil PA, McGraw-Hill, ISBN: 9781259837937.
4. Lippincott's Illustrated Reviews Biochemistry (2017) 7th ed., Ferrier, Wolters Kluwer India Pvt. Ltd., ISBN: 978-9351297949.
5. Biochemistry (2019) 9th ed., Stryer L, Berg JM, Tymoczko JL, Gatto Jr. GJ, W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9.


12/6/2019



SEMESTER-I

Course title: General Microbiology
Course code: SIAL SC 1 1 03 C 3003

Credit: 3
Lecture: 45

Course objective: To provide an understanding of basic concepts and techniques in Microbiology.

Learning outcomes:

- Demonstrate the practical skills in basic microbiological techniques
- Designate the role of microorganisms in different ecosystems
- Retrieve and use contemporary information on different microbial groups

Unit-I

History of development of Microbiology in 20th century; The spontaneous generation controversy; Germ theory of disease; Methods in microbiology: Physical and chemical methods of sterilization; Pure culture techniques, maintenance and preservation of microbial cultures.

Unit-II

Binomial nomenclature; Haeckel's three kingdom classification; Organization of archae, bacteria and eukaryotic cell; Use of DNA and r-RNA sequencing in classification of microorganisms; Woese's three kingdom classification system and its utility - archaea, eubacteria, eukarya; Different groups of acellular microorganisms - viruses, viroids and prions.

Unit-III

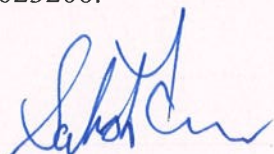
General features of microorganisms - bacteria, algae, fungi and protozoa; Bacterial growth and metabolism; Microbes in different environment: extreme environment, deep ocean, space and air. Special features of the thermophilic, methanogenic and halophilic bacteria; Photosynthetic bacteria, Cyanobacteria.

Unit-IV

Scope of Microbiology - Cycle of matter in nature; Microbial interactions – Symbiosis and parasitism; Biodegradation and Bioremediation; Biofilms; Microbes in composting; Biofertilizers and Biopesticides; Microbes and Industry - SCP, microbial enzymes and fermented foods, Vaccines and antibiotics.

Suggested readings:

1. An Introduction to Microbiology (2019), 3rded., Tauro P, Kapoor KK, Yadav KS, and Sequeira MG. New Age International Publishers. ISBN: 0852268785.
2. Brock Biology of Microorganisms (2018), 15thed., Madigan MT, Martinko JM, Bender KS, Buckley DH, Stahl DA. Pearson Education, ISBN 9781292235103.
3. Prescott's Microbiology (2017). 10th ed. Sherwood LM, Woolverton C.J McGraw-Hill Education. ISBN 9781259281594.
4. A text book of Microbiology (2013), 3rd ed. Dubey, R.C. and Maheswari, D.K. Revised S. Chand and Company Ltd, New Delhi. ISBN: 9788121926201.
5. Microbiology (2001) 5th ed., Pelczar Jr. M, McGraw Hill Education ISBN: 9780074623206.



SEMESTER-I

Course title: Genetics

Course code: SIAL SC 1 1 04 C 3003

Credit: 3

Lecture: 45

Course objective: To study the fundamental concepts of genetics and its role in unification of different disciplines of biology.

Learning outcomes:

- Understanding of basic concepts of classical genetics and genetic analysis of eukaryotes

Unit-I

Historical background, Principles of Mendelian inheritance, codominance, incomplete dominance, Gene interactions, pleiotropy, Extra chromosomal inheritance: Maternal inheritance (mitochondria and chloroplast), Sex linked inheritance, Sex influenced and Sex limited traits, Gene interactions: Incomplete dominance, codominance, duplicate genes, complementary genes, supplementary genes, lethal genes, pleiotropic genes and multiple alleles.

Unit-II

Linkage: complete and incomplete linkage, linkage analysis and genetic maps, Linkage and recombination of gene, Mechanism of crossing over, Population Genetics and Hardy-Weinberg equilibrium. Genetic analysis: Linkage maps, mapping with molecular markers, Gene mapping by three point test cross, Tetrad analysis, Sex determination and Dosage compensation in Mammals and Drosophila, Quantitative Genetics: Multilocus control; QTL analysis; Quantitative inheritance in plants and human.

Unit-III

Mutations: concept and types, Mechanism of spontaneous mutations, Physical and chemical mutagenesis, Selection and enrichment of mutants, Molecular mechanism of induced mutations, importance of mutation; detection of mutation and directed mutagenesis, Germinal and somatic mutation, insertion, deletion, duplication, translocation, transposition, Numerical alterations of chromosomes: Ploidy and their genetic implications. Types of DNA repair, Molecular mechanism of suppression.

Unit-IV

Nucleosome and chromatin structure, Structure of centromere and telomere, Euchromatin and heterochromatin, Polytene and lamp brush chromosomes, Gene transfer in prokaryotes: Transformation, Conjugation and Transduction, Transposons: types, structures and role in gene regulation, Natural and artificial competence, Operon concept in bacteria and gene regulation, Bacterial plasmids, Lytic and lysogenic cell cycles in Phages.

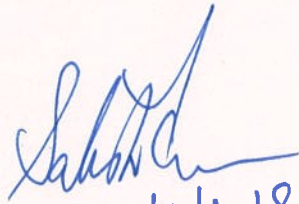
Suggested readings:

1. Principles of Genetics (2006) 8th ed. Gardner EJ, Simmons, MJ and Snustad DP, John Wiley & Sons Inc, ISBN: 8126510439.
2. Essentials of Genetics (2015) 9th ed. William S, Michael K, Cummings R, Spencer, CA and Palladino MA, Prentice Hall Internationals, ISBN-10: 0134047796
3. Genetics (2017) 9th ed. Daniel L. Hartal & B. Cochrane, ISBN: 128412293X
4. Introduction to Quantitative Genetics (1995) Falconer DS, and Mackay TFC, ISBN: 0582243025.

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5. An Introduction to Population Genetics Theory and applications (2013) Nielsen R and Slatkin M, Oxford University Press, ISBN: 1605351539.
6. Evolution 4th ed. (2017) D. Futuma and M. Kirkpatrick, ISBN: 9781605356051
7. An Introduction to Genetic Analysis (2015) Griffith AJFJ, Wessler SR, Carroll SV and Doebley J, ISBN: 0-7167-3520-2.


12/6/19



SEMESTER-I

Course title: Analytical Techniques
Course code: SIAL SC 1 1 05 C 3003

Credit: 3
Lecture: 45

Course objective: To provide an advanced understanding of the core principles of various techniques used in biological experiments.

Learning outcomes:

- Demonstrate principles of various basic and advanced techniques used in biological experiments
- Critically analyze and interpret the results obtained from biological experiments

Unit-I

Principle of microscopy: resolving powers of different microscopes, magnification; different types of microscopes, principle and applications of compound microscopy, dark microscopy, fluorescence microscopy, phase contrast microscopy, confocal microscopy, atomic force microscopy and electron microscopy (SEM, TEM, STEM); fixation and staining, freeze fracture/etch techniques.

Unit-II

Agarose gel electrophoresis, polyacrylamide gel electrophoresis (native PAGE and SDS-PAGE); Western transfer, iso-electric focusing (IEF); 2-Dimensional gel electrophoresis, pulse field electrophoresis; principle and applications of centrifugation, differential centrifugation, density gradient centrifugation and ultracentrifugation; cell separation by flow cytometry.

Unit-III

Paper chromatography (ascending and descending, 2-Dimensional); principle and applications of thin layer chromatography (TLC), column chromatography (gel filtration, ion exchange and affinity chromatography); methods of ligand immobilization, immuno-adsorption-hydrophobic interaction chromatography, metal chelate chromatography, covalent chromatography, high performance liquid chromatography (HPLC) and gas liquid chromatography (GLC).

Unit-IV

Principle and instrumentation of UV-visible, infrared spectroscopy, atomic absorption spectrophotometry, NMR spectroscopy, X-ray diffraction spectroscopy, N-terminal sequencing and peptide synthesis, introduction to proteomics, Yeast 2- hybrid and 3-hybrid systems, EMSA, foot printing, phage display, principle of mass spectrometry, electrospray ionization MS, MALDI, tandem MS for protein identification, ICAT-MS.

Suggested readings:

1. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Wilson K and Walker J, Cambridge University Press, ISBN No. 131661476X.
2. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder D, W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.

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SEMESTER – I

Course Title: Practical-I

Course Code: SIAL SC 1 1 06 C 00105

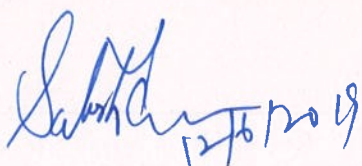
Credit: 5

Lecture: 150

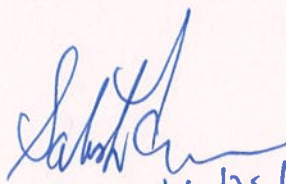
1. Laboratory orientation, calibration, and demonstration of equipment.
2. Solutions, pH and buffers
3. Determination of pKa of acetic acid and glycine
4. Qualitative tests for carbohydrates, lipids, amino acids, and proteins in food samples
5. Metaphase chromosome preparation with G banding and C banding from blood sample
6. RNA *in-situ* hybridization to study gene expression in tissue section
7. Inheritance patterns in man – numerical on pedigree analysis- autosomal patterns, X-linked patterns, Y-linked patterns, mitochondrial inheritance patterns
8. Numerical on Hardy-Weinberg equilibrium
9. Numerical on linkage mapping
10. Different staining methods and microscopic examination of bacteria, actinomycetes, algae, fungi and protozoa
11. Preparation of specific media for isolation of bacteria, and fungi from natural sources
12. Cell counting and cell viability assay
13. Production of microbial enzymes (amylase, phosphatase) and their separation using chromatographic techniques
14. Biochemical characterization of microbial enzymes.
15. Separation of carbohydrates, amino acids and plant pigments using paper/thin layer chromatography
16. Detection of food adulterants
17. Evaluation of microbiological risks in food processing unit through microbiological risk assessment (MRA) tools
18. Assessment of nutritional status of different age group using anthropometric tools

Suggested readings:

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D, Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.
2. An Introduction to Practical Biochemistry (2017) 3rd ed., Plummer, D.T., McGraw Hill Education, ISBN: 978-0070994874.
3. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Wilson K, and Walker J, Cambridge University Press. ISBN: 131661476X.
4. Microbes in Action: A Laboratory Manual of Microbiology (1990) 4th Addition, Harry W, Seeley, Paul JV, John J, W. H. Freeman ISBN: 978-0716721000.



5. Genetics: A Laboratory Manual, (2009) 2nd ed., American Society of Agronomy; Lab Manual edition, ISBN: 978-0891185611.
6. Infant, Child and Adolescent Nutrition: A Practical Handbook (2013) 1st ed., More J, CRC Press, ISBN: 9781444111859.
7. Laboratory Manual of Microbiology and Biotechnology (2014) 1st ed. Aneja KR, Scientific International Pvt., Ltd. ISBN: 9789381714553.
8. Microbiology: A Laboratory Manual (2017), 11th ed., Cappuccino, JH, Sherman, N., Pearson Education Inc, ISBN: 9780134298597.
9. An introduction to Practical Biochemistry (2017) 3rd ed., Plummer, DT, McGraw Hill Education, ISBN: 978-0070994874.


12/6/2019



SEMESTER – I

Course title: Biofertilizer and Compost Technology
Course code: SIAL MB 1 1 01 GEC 4004

Credit: 4
Lectures: 60

Course objective: To familiarize the students with the basic concepts regarding the use of microorganisms as biofertilizers and compost inoculants, their mass production and quality assurance.

Learning outcomes:

- Understanding the use of microorganisms as biofertilizer and compost inoculant
- Understanding various applications of microbial inoculants in agriculture and solid waste management

Unit-I

Principles of crop inoculation with microbial agents, organic farming-role of biofertilizers and organic manures; overview of microbial inoculants-types and their mode of application, types of formulation- advantages and disadvantages.

Unit-II

Carriers for inoculants: types and their characteristics, strain selection of bacteria and cyanobacteria for biofertilizer production and quality control, mass multiplication: methodology and constraints/benefits, bulk production (small scale and commercial scale), setting up of pilot scale inoculant production plants.

Unit-III

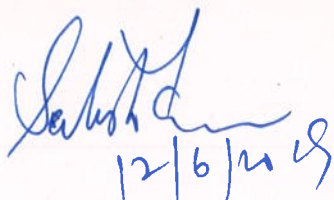
Rhizobium: Isolation, characterization and formulation; *Azotobacter*: isolation, characterization and formulation; phosphate solubilizing microorganisms: isolation, characterization and formulation; am fungi- types, multiplication methods and formulations; ecology of inoculants/ microorganisms in soil, cyanobacteria as biofertilizer for paddy cultivation.

Unit-IV

Composting- microbiology, types and quality testing; vermi-compost: types of earthworms, production technology and its evaluation; biocontrol agents: evaluation and formulations; biogas production technology; silage production.

Suggested Readings:

1. Sustainable Green Technologies for Environmental Management (2019). 1st ed. Shachi SV and Venkatramanan, RP, Springer (Singapore) ISBN 9789811327711.
2. Solid Waste as a Renewable Resource: Methodologies (2015) 1st ed. Albanese, JAF and Ruiz, MP CRC Press. ISBN 9781771882439.
3. Biofertilizer Technology (2013) 1st ed., Kannaiyan, S, Kumar, K and Govindarajan K Scientific Publisher. ISBN 9789386102485.
4. Compost Science and Technology, Vol 8. (2011) 1st ed. Diaz LF, De Bertoldi M and Bidlingmaier W, Elsevier, ISBN 9780080439600
5. Microbes for Sustainable Agriculture (2010) Tilak, KVBR, Pal, KK and De, R. I.K. International Publishing House Private Ltd. (New Delhi) ISBN 9789380026886


12/6/2019



SEMESTER – I

Course title: Techniques in Microbiology
Course code: SIAL MB 1 1 02 GEC 4004

Credit: 4
Lectures: 60

Course objective: To familiarize with General Microbiological techniques and understand their principles and to learn the applications of various techniques in identification and application of microorganisms.

Learning outcomes:

- Know-how of the basic microbiological tools and techniques
- Understanding of applications of techniques for exploitation of microbes
- Ability to grow and identify specific microorganisms

Unit-I

Isolation and cultivation of pure cultures- microbiological culture media; Maintenance of asepsis - Autoclave, Hot air oven, Filtration, Laminar air flow; Isolation of bacteria (streak plate, spread plate, pour plate, serial dilution methods) screening and enrichment techniques; preservation and maintenance of microbial cultures, general setup of microbiological laboratory.

Unit-II

Principle and applications of bright field and dark field microscopy; Microscopic measurements, Phase contrast, Interference, Differential Interference Contrast Microscopy; Fluorescence, Immunofluorescence and Confocal Microscopy; Specimen preparation in Light and Electron Microscopy; Simple staining, differential staining, acid fast staining, staining for visualization of specific microbial cell structures; SEM, TEM, and STEM.

Unit-III

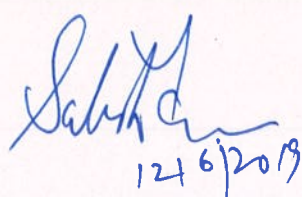
Factors affecting microbial growth, Estimation of microbial growth - direct and indirect methods for determination of numbers - viable (plate) count and total (Haemocytometer) count, Estimation of microbial biomass, determination of bacterial growth rate and generation time by turbidometry method, estimation of microbial protein and enzyme activities.

Unit-IV

Tools and techniques for microbial identification and characterization – morphological characterization of microbial cells and colonies, phenotypic methods (biochemical and physiological properties); molecular biology tools for identification and characterization of microbes, measurement of microbial metabolism; detection of non-culturable microbes and metagenomics.

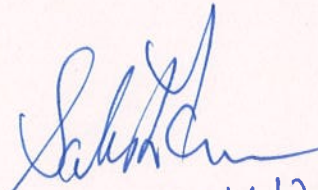
Suggested readings:

1. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018), 8th ed., Hofmann A and Clokie S, Cambridge University Press (NY), Online ISBN: 9781316677056.
2. Experiments in Microbiology, Plant Pathology and Biotechnology (2009), 1st ed., Aneja KR, New Age International Publishers (New Delhi), ISBN-13: 978-8122414943.


12/6/2019



3. Microbiology: A Laboratory Manual (2017), 11th ed., Cappuccino JH and Sherman N, Pearson Education Inc, ISBN: 9780134298597.
4. An introduction to Practical Biochemistry (2017) 3rd ed., Plummer DT, McGraw Hill Education, ISBN-13: 978-0070994874.


12/6/2019



SEMESTER-II

Course title: Immunology

Course code: SIAL SC 1 2 07 C 4004

Credit: 4

Lecture: 60

Course objective: To understand overall organization of the immune system and to identify the cellular and molecular basis of immune responsiveness.

Learning outcomes:

- Understanding the working mechanism of the immune system
- Understanding of antibody, MHC, complement system, cytokines, cancer, and organ transplant hypersensitivity

Unit-I

Host-defenses, hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT). Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, chemokines. Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

Unit-II

Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family. Multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification. Antigen independent phase of B cell maturation and selection, humoral response – T-dependent and T-independent response.

Unit-III

Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies. General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, pathways of antigen processing and presentation. Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation. General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

Unit-IV

Mechanism of tolerance, Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity. Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy, Immunohistochemistry, Immunocytochemistry and privileged sites. Vaccines - active and passive immunization, types of vaccines.


Suggested readings:

1. Kuby Immunology (2018) 8th ed., Punt J, Stranford S, Jones P and Owen JA, W.H Freeman and Company, ISBN: 978-1319114701.
2. Janeway's Immunobiology (2017) 9th ed., Murphy KM and Beaver C, WW Norton and Company, ISBN: 978-0815345510.

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3. Roitt's Essential Immunology (2017) 13th ed., Delvis PJ, Martin SJ, Burton DR and Roitt, IM, Wiley-Blackwell, ISBN: 978-1118415771.
4. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
5. Lippincott's illustrated Reviews Immunology (2012) 2nd ed., Doan T, Melvold R, Viselli S and Waltenbaugh, C, Wolters Kluwer India Pvt, Ltd, ISBN: 978-8184737639.


12/6/2019



SEMESTER-II

Course title: Biosafety, Bioethics and IPR

Course code: SIAL SC 1 2 08 C 3003

Credit: 3

Lecture: 45

Course objective: To introduce the concept of intellectual property rights, patenting and emphasis on biosafety and bioethics.

Learning outcomes:

- Understanding the basics of intellectual property rights
- Understand the importance and level of biosafety at laboratory and industrial levels
- Understand ethical practices and concepts appropriate to the discipline

Unit-I

Biosafety: introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs; principles of safety assessment of transgenic plants – sequential steps in risk assessment; concepts of familiarity and substantial equivalence; risk – environmental risk assessment and food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan; risk assessment of transgenic crops vs cisgenic plants or products derived from RNAi, genome editing tools. Regulations: International regulations-Cartagena protocol, OECD consensus documents and Codex Alimentarius; Indian regulations-EPA act and rules, guidance documents, regulatory framework-RCGM, GEAC, IBSC and other regulatory bodies.

Unit-II

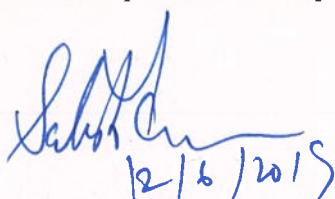
Bioethics: Introduction, ethical conflicts in biological sciences-interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research - cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology-Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity - biopiracy.


Unit-III

Patenting: Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications, PCT and conventional patent applications.

Unit- IV

International patenting-requirement, procedures and costs; financial assistance for patenting, introduction to existing schemes; publication of patents-gazette of India, status in Europe and US;

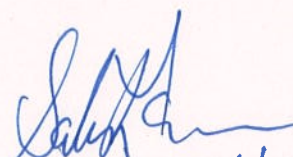

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patent infringement- meaning, scope, litigation, case studies and examples; commercialization of patented innovations; licensing-outright sale, licensing, royalty; patenting by research students and scientists-university/organizational rules in India and abroad, collaborative research-backward and forward IP; benefit/Credits sharing among parties/community, commercial (financial) and non-commercial incentives.

Suggested readings:

1. Office of the Controller General of Patents, Design & Trademarks; Department of Industrial Policy & Promotion; Ministry of Commerce & Industry; Government of India. <http://www.ipindia.nic.in/>
2. World Trade Organisation. <http://www.wto.org>
3. World Intellectual Property Organisation. <http://www.wipo.int>
4. International Union for the Protection of New Varieties of Plants. <http://www.upov.int>
5. National Portal of India. <http://www.archive.india.gov.in>
6. IPR, Biosafety and Bioethics (2013) Parashar S, Goel D, Pearson Publishing India, ISBN: 9788131774700.
7. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology (2017) Nambisan P, Academic Press, ISBN: 9780128092316.
8. <http://dbtindia.gov.in/guidelines-biosafety>


12/6/14



SEMESTER-II

Course title: Microbial Diversity
Course code: SIAL MB 1 2 01 C 4004

Credit: 4
Lectures: 60

Course objectives: To make the students understand the basic structure, classification and importance of different microbial groups.

Learning outcome:

- Understanding the diversity of microbial world and their implications
- Understanding the characteristics and significances of different microbial groups

Unit-I

Organization of Bacterial Cell - Structure and function of cell wall, cell membrane, cytoplasm, flagella, endoflagella, fimbriae, glycocalyx, capsule, endospore; bacterial classification, important archaeal group, Archaeobacteria, Eubacteria- General characteristics, ecological significance and economic importance

Unit-II

Cellular organization of algal and fungal cells; algae - occurrence and distribution, thallus structure, characteristics, classification and reproduction; lichens and mycorrhiza - occurrence, structure, types and importance; fungi – occurrence, distribution and classification, fungal metabolites and their potential applications in food, agriculture, industry and environment.

Unit-III

Discovery and general characteristics of viruses; capsid symmetry; enveloped and non-enveloped viruses; classification and nomenclature of different groups (animal viruses and plant viruses) of viruses; viroids, virusoids, satellite viruses and prions; bacteriophages; lytic and lysogenic phages (lambda phage); phage therapy.

Unit-IV

Protozoan general characteristics and classification based on flagellate or mastigophora, rhizopoda, ciliophora, and sporozoa; detailed study of euglena, monocyctis, entameoba, paramecium and trypanosoma; role of protozoan in environment and health implication.

Suggested readings:

1. An Introduction to Microbiology (2019), 3rded., Tauro P, Kapoor KK, Yadav KS and Sequeira MG. New Age International Publishers. ISBN: 0852268785.
2. Principles of Microbial Diversity (2015), Brown JW, ASM Press, Washington DC, ISBN-10: 9781555814427.
3. Microbial Diversity in the Genomic Era (2018) 1sted., Das S and Dash H, Academic Press, ISBN: 9780128148501.
4. Virology: Principles and Applications (2013) 2nded, Carter J and Saunders V, John Wiley & Sons, ISBN: 9781119991434.
5. Prescott's Microbiology (2017) 10th ed., Willey J, Sherwood L, and Woolverton CJ. McGraw-Hill Education, ISBN-1259281590.
6. The Fungi (2015) 3rd ed., Watkinson S, Boddy L and Nicholas M. Academic Press. ISBN: 978012382035

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SEMESTER-II

Course title: Microbial Physiology and Metabolism
Course code: SIAL MB 1 2 02 C 4004

Credit: 4
Lectures: 60

Course objective: The course is designed to describe metabolic and physiological diversity among prokaryotes.

Learning outcome:

- Learning of principles of microbial catabolic and anabolic pathways
- Understanding the transport systems and the mechanisms of energy conservation in microbial metabolism
- Identifying various physiological groups of bacteria with their special features

Unit-I

Nutritional categories of microorganisms based on carbon and energy sources; Metabolite transport - passive and facilitated, primary and secondary active transport, group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electroneutral transport, transport of iron; Microbial Growth - Definition balanced and unbalanced growth, growth curve, the mathematics of growth, generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxic growth curve; Effect of physical and chemical factors on growth.

Unit-II

Brief account of photosynthetic and accessory pigments - chlorophyll, bacteriochlorophyll, rhodopsin, carotenoids, phycobiliproteins; Autotrophy - oxygenic, anoxygenic photosynthesis; Autotrophic generation of ATP; Fixation of CO₂; Calvin cycle pathway. Chemolithotrophy - Sulphur, iron, hydrogen, nitrogen oxidations, methanogenesis, Bioluminescence.

Unit-III

Respiratory metabolism - Embden-Mayer Hoff pathway, Entner Doudroff pathway, Pentose phosphate pathway, Krebs cycle, Branched TCA cycle, Reverse TCA cycle, glyoxalate pathway, oxidative and substrate level phosphorylation, gluconeogenesis, pasteur effect; fermentation of carbohydrates - homo and heterolactic fermentations; halophiles and atp synthesis.

Unit-IV

Biosynthesis of peptidoglycan, polysaccharides, major amino acids, polyamines, lipids, nucleotides - purines and pyrimidines; assimilation of nitrogen; dormancy and germination; microbial differentiation, sporulation and morphogenesis, cell division cycle in *e. coli* and yeast.

Suggested readings:

1. An Introduction to Microbiology (2019), 3rd ed., Tauro P, Kapoor KK, Yadav KS, and Sequeira MG, New Age International Publishers. ISBN: 0852268785
2. Microbial Biochemistry (2014) Cohen GN, 3rd edition. Springer Netherlands. ISBN 978-90-481-9437-7
3. The Physiology and Biochemistry of Prokaryotes. (2011) White D, Dummond J and Fuqua, C, 4th edition. Oxford University Press. ISBN: 9780195393040

Sahil
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Arjun

4. Prescott's Microbiology (2017) 10th ed., Willey J, Sherwood L and Woolverton CJ. McGraw-Hill Education, ISBN: 1259281590
5. A text book of Microbiology (2013), Dubey RC and Maheswari, DK Revised S. Chand and Company Ltd, New Delhi. ISBN: 9788121926201

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SEMESTER-II

Course title: Soil and Agriculture Microbiology

Course code: SIAL MB 1 2 03 C 4004

Credit: 4

Lectures: 60

Course objective: To teach the basic concepts related to soil environment in relation to microbes and plant-microbe interaction including pathogens

Learning outcome:

- Understanding the role of microorganisms in the biogeochemical cycles of nutrients
- Understanding the role of microbes in degradation of solid organic waste and other organic pollutants.
- Understanding the different types of interactions between plants and microbes

Unit-I

History of development of soil microbiology; soil microorganisms: major groups, their diversity, abundance, characteristics; direct and indirect methods of studying soil microorganisms and their activities; microorganisms and their enzymes in soil fertility; influence of soil and environmental factors on microflora; soil health-major microbial indicators and their significance

Unit-II

Microorganisms in biogeochemical cycles of carbon, nitrogen, phosphorus, sulphur, iron and manganese; biodegradation of starch, cellulose, hemicellulose, pectin and lignin in soil; biodegradation of pesticides and other xenobiotics; production of biogas; composting-microbiology, types and factors affecting composting; vermicomposting, green manuring

Unit-III

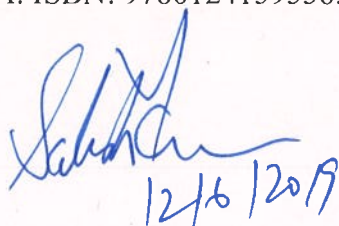
Plant-microbe interactions, Concepts of Rhizosphere, R:S ratio, Rhizoplane, spermosphere, phyllosphere microorganisms; Biological Nitrogen fixation - symbiotic, non-symbiotic, associative symbiotic and endophytic organisms, process of nitrogen fixation; Molecular biology of Nitrogen fixation

Unit-IV

Biofertilizers – Types (Bacterial, fungal and algal), mass production and quality assurance; Microbial Biocontrol agents for insects and diseases- development and their significance. Mycorrhizae, Types of mycorrhizae and their interactions with plants

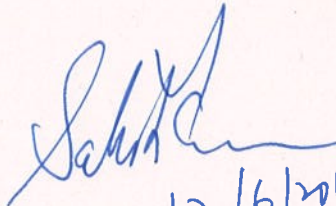
Suggested readings:

- Rhizotrophs: Plant Growth Promotion to Bioremediation (2017) vol 2. Mehnaz S, Springer, ISBN: 9789811048616.
- Plant, Soil and Microbes Vol-1 Implications in Crop Science (2016) 1st ed., Hakeem KR, Akhtar MS and Abdullah SNA, Springer Cham, ISBN: 9783319274539.
- Principles of plant-microbe interactions (2016) Lugtenberg B, Springer Cham, ISBN 3319381857.
- Soil Microbiology, Ecology and Biochemistry (2017) 4th ed. Paul EA, Academic Press, New York, USA. ISBN: 9780124159556.


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- Principles and Applications of Soil Microbiology (2005) 2nd ed., Sylvia D, Fuhrmann J, Hartel P and Zuberer D Pearson Education, USA. ISBN: 9780130941176.
- Introduction to Soil Microbiology (1985) 3rd ed., Alexander M, Wiley Eastern, New Delhi. ISBN: 9780894645129.


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SEMESTER-II

Course title: Practical-II

Credit: 5

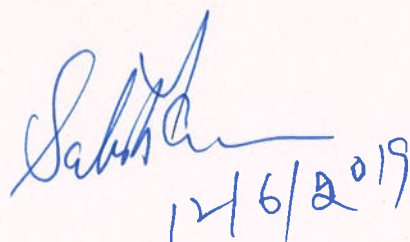
Course code: SIAL MB 1 2 04 C 00105


Lectures: 150

1. Morphological, physiological and biochemical characterization of bacterial cultures.
2. Isolation and identification of fungi and algae from different environmental samples;
3. Study of virus architecture using electron microphotographs of TMV, poliovirus and adenovirus;
4. Discussion on cultivation and cytopathic effects of animal viruses;
5. Bacteriophage assay using the plaque technique
6. Determination of bacterial growth by turbidity measurements (Bacterial growth curve);
7. To study the types of growth (synchronous/ diauxic, batch);
8. To study the effect of incubation temperature, pH, salts on the growth of microorganisms;
9. Isolation of different bacterial and fungal organisms important in recycling of C, N, P in soil;
10. Measurement of CO₂ evolution rate to study decomposition in soil,
11. Estimation of different Soil enzymes- (dehydrogenase/ FDA hydrolase/ β -glucosidase)
12. Determination of Microbial biomass carbon
13. Determination of RS ratio of soil
14. Determination of quality of milk by methylene blue reductase test (MBRT) and SPC;
15. Microbiological examination of different food samples;
16. Determination of antibacterial activity of lactic acid bacteria
17. Screening of microorganisms from soils and industrial effluents for bioremediation applications
18. Microbiological quality control tests for water;
19. Agglutination and Precipitation based assays
20. Immunodiffusion assays by Ouchterlony method;
21. Demonstration of Immunoelectrophoresis; Dot-ELISA and Western blotting

Suggested readings:

1. Microbiology: A laboratory Manual (2017) 11th ed. Cappuccino JG and Welsh C, Pearson Education, Inc. ISBN: 9780134098630.
2. Laboratory Manual of Microbiology and Biotechnology (2014) 1st ed. Aneja KR., Scientific International Pvt. Ltd. ISBN: 9789381714553.


12/6/2019



SEMESTER-II

Course title: Research Methodology and Scientific Communication Skills

Credit: 2

Course code: SIAL SC 1 2 10 DCEC 2002

Lectures: 30

Course objective: To provide knowledge about tools and techniques related with scientific communication and research methodology.

Learning outcomes:

- Understanding the existence of scientific knowledge in ancient times
- Acquiring the skills of scientific reading, writing and presentations
- Appreciating the scientific ethics through case studies

Unit-I

Empirical science; scientific method; manipulative experiments and controls; deductive and inductive reasoning; descriptive science; reductionist vs holistic biology.

Unit-II

Choosing a mentor, lab and research question; maintaining a lab notebook. Concept of effective communication- setting clear goals for communication; determining outcomes and results; initiating communication; avoiding breakdowns while communicating; creating value in conversation; barriers to effective communication; non-verbal communication-interpreting non-verbal cues; importance of body language, power of effective listening; recognizing cultural differences.

Unit-III

Presentation skills - formal presentation skills; preparing and presenting using over-head projector, PowerPoint; defending interrogation; scientific poster preparation & presentation; participating in group discussions; Computing skills for scientific research - web browsing for information search; search engines and their mechanism of searching; hidden Web and its importance in scientific research; internet as a medium of interaction between scientists; effective email strategy using the right tone and conciseness.

Unit-IV

Technical writing skills - types of reports; layout of a formal report; scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts; publishing scientific papers - peer review process and problems, recent developments such as open access and non-blind review; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.

Suggested readings:

1. Research Methodology: Methods And Techniques (2019) 4th ed., Kothari CR and Garg G, New Age International Publishers, ISBN: 978-9386649225.
2. Communicate Science Papers, Presentations, and Posters Effectively (2015) Patience GS, Boffito DC, Patience P, Academic Press, ISBN: 978-0128015001.

Sabita
12/6/2019

Supriya

3. Successful Scientific Writing: A Step-by-Step Guide for the Biological and Medical Sciences (2014) 4th ed., Matthews JR and Matthews RW, Cambridge University Press ISBN: 978-1107691933.
4. Doing Science: Design, Analysis, and Communication of Scientific Research. (2001) Valiela I, Oxford: Oxford University Press, ISBN 10:019538573X.
5. On Being a Scientist: a Guide to Responsible Conduct in Research. (2009) 3rd ed., Washington DC, National Academies Press.

Sahsh
12/6/2015

Luja

SEMESTER-II

Course title: Bio-entrepreneurship
Course code: SIAL SC 1 2 11 DCEC 2002

Credit: 2
Lectures: 30

Course objectives: To teach students about concepts of entrepreneurship including identifying a winning business opportunity, gathering funding and launching a business, growing and nurturing the organization and harvesting the rewards.

Learning Outcomes:

- Gain entrepreneurial skills and understand the various operations involved in venture creation
- Identifying scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centres and various agencies

Unit-I

Introduction and scope in Bio-entrepreneurship, Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech), Strategy and operations of bio-sector firms: Factors shaping opportunities. For innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities, Alternatives faced by emerging bio-firms and the relevant tools for strategic decision, Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies.

Unit-II

Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills.

Unit-III

Business plan preparation including statutory and legal requirements, Business feasibility study, financial management issues of procurement of capital and management of costs, Collaborations & partnership, Information technology.

Unit-IV

Technology – assessment, development & upgradation, Managing technology transfer, Quality control & transfer of foreign technologies, Knowledge centers and Technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GCP, GLA, GMP).

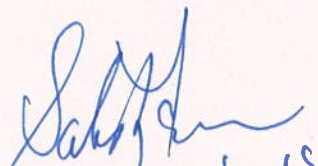
Suggested readings:

1. Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge, Routledge Studies in Innovation, Organizations and Technology (2018) 1st ed. Onetti, A, & Zucchella, A, CRC press, Taylor and Francis group. ISBN: 9781138616905.

Sahish
12/6/2019

Surjan

2. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Shimasaki, CD (2014) Amsterdam: Elsevier. Academic Press is an imprint of Elsevier, ISBN: 0124047300.
3. Innovation, Commercialization, and Start-Ups in Life Sciences. (2014) 1st ed. Jordan, JF, CRC Press. Taylor and Francis group, ISBN: 9781482210125.
4. The Dynamics of Entrepreneurial Development and Management. (2011) 6th ed., Desai V, New Delhi: Himalaya Pub. House, ISBN: 9350244543.
5. Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences (2008) Adams, DJ, Sparrow JC, Bloxham, Scion, ISBN:1904842364.


12/6/2019



SEMESTER-II

Course title: Food and Dairy Microbiology

Credit: 4

Course code: SIAL MB 1 2 01 DCEC 4004

Lectures: 60

Course Objectives: This course is designed to provide information on role of microbiology in Food processing sector. The major objective of this course will be comprehensive understanding of role of microorganisms in: food production, spoilage preservation, quality and safety and the recent technological interventions in these areas of Food.

Learning outcomes:

- Understanding the interactions between microorganisms and the food environment
- Understanding different bioprocesses involved in production and preservation of foods
- Understanding the importance of microbiological quality and preventive measure for food borne diseases

Unit-I

Natural flora and source of contamination of foods; intrinsic and extrinsic factors that affect growth and survival of microbes in foods; microbial spoilage of vegetables, fruits, meat, eggs, milk, bread, butter, and canned foods.

Unit-II

Principles of food preservation; physical methods of food preservation - temperature (low, high, canning, and drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging; chemical methods of food preservation - salt, sugar, organic acids, so₂, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins; food sanitation - HACCP, indices of food sanitary quality and sanitizers.

Unit-III

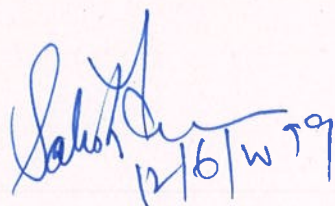
Fermented foods - dairy starter cultures and fermented dairy products (yogurt, acidophilus milk, curd, kefir, kumiss, cheese, dosa, sauerkraut, soy sauce and tempeh); probiotics and prebiotics - health benefits, types of microorganisms used, probiotic foods available in the indian market.

Unit-IV

Food-borne diseases (causative agents, foods involved, symptoms and preventive measures) - Food intoxications caused by *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Food infections caused by *Bacillus cereus*, *Vibrio parahaemolyticus*, *Escherichia coli*, *Salmonella*, *Shigella*, *Yersinia enterocolitica*, *Listeria monocytogenes* and *Campylobacter jejuni*; Conventional and recent methods for detection of food-borne pathogens. Indian and International regulations of food quality and safety.

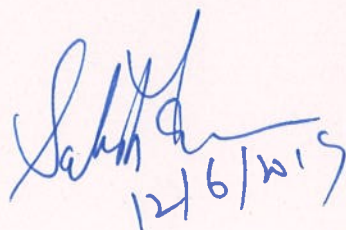
Suggested readings:

1. Fundamental Food Microbiology (2014). 5th ed.. Ray B and Bhunia A CRC Press, Taylor and Francis Group. ISBN 9781466564435.


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2. Food Microbiology: Principles into Practice. Microorganisms related to foods, foodborne diseases and food spoilage, (2016) Volume 1 and 2, Erkman O and Bozoglu TF, John Wiley & Sons, Inc. ISBN: 9781119237761.
3. Food Microbiology (2016) 4th ed., Adams MR, Moss M and McClure P, Royal Society of Chemistry. ISBN: 978-1849739603.
4. Microbiology in Dairy Processing: Challenges and Opportunities (2017) Poltronieri P, John Wiley & Sons Ltd and the Institute of Food Technologists ISBN: 1119114802.
5. Food Microbiology (2002) 4th ed. Frazier WC and Westhoff DC, Tata McGraw-Hill Publishing Company Ltd, New Delhi, India. ISBN: 9780070219212.


12/6/2019



SEMESTER-II

Course title: Environmental Microbiology
Course code: SIAL MB 1 2 02 DCEC 4004

Credit: 4
Lectures: 60

Course objectives: To understand the role of microorganisms in environmental processes and also to learn principles and applications of microbiology in bioremediation of pollutants and wastewater treatment.

Learning outcomes:

- Know-how of the effect of environmental condition on microbes
- Understanding the interactions between microorganisms and their environment
- Understanding of applications of microorganisms in solving environmental problems

Unit-I

Historical developments and contributions of scientists in environmental microbiology; introduction and scope of environmental microbiology; environmental factors affecting microbial growth; impacts of GMOs on environment; role of microorganisms in mitigating global climate change; tools and techniques for studying microbial interactions with their environment.

Unit-II

Microbiology of natural environments: terrestrial environments; rhizosphere; aquatic environments (freshwater, marine and estuarine habitats); ground water; aeromicroflora and dispersal of microbes; human microbiomics; microbial interactions in rumen.

Unit-III

Microbiology of extreme environments: microbial growth and survival under hot environments, cold environments, alkaline environments, acidic environments, saline environments, environments rich in heavy metal, low nutrient environments, environments with high hydrostatic pressure, organic solvents and radiation; polyextremophiles. Space microbiology.

Unit-IV

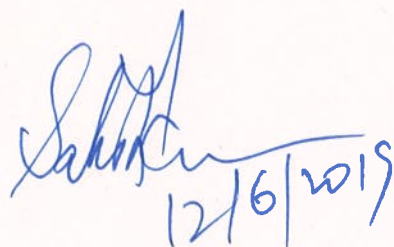
Microbial indicators of environmental pollution; bioremediation of recalcitrant organic pollutants; microbial technology for waste management and treatment- solid waste management, landfills, utilization of solid wastes for production of food and feed, fuel and fertilizer; wastewater microbiology: microbiology of sewage and industrial effluents (paper and pulp, distillery etc.) - aerobic (trickling filters, activated sludge, oxidation ponds etc.) and anaerobic processes in wastewater treatment; enhanced recovery of metals, petroleum and bioenergy from natural resources. Biodegradation and biodeterioration.

Suggested readings:

1. Manual of Environmental Microbiology (2016), 4th ed., Yates, MV, Nakatsu CH, Miller RV and Pillai RV, ASM Press (USA), Print ISBN: 9781555816025, e-ISBN : 9781555818821.
2. Environmental Microbiology for Engineers (2016), 1st ed., Ivanov V, ISBN: 9780429109003.
3. Environmental Microbiology: From Genomes to Biogeochemistry (2015), 2nd ed., Madsen EL, John Wiley & Sons, Inc., ISBN: 978-1-118-43963-0.

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4. Environmental Microbiology: Fundamentals and Applications (2015), 1st ed., Bertrand JC, Caumette P, Lebaron, P, Matheron R, Normand P and Sime-Ngando T, Springer Netherlands, eBook ISBN: 978-94-017-9118-2, Hardcover ISBN: 978-94-017-9117-5.
5. Environmental Microbiology (2016-17), 1st ed., Sharma, PD, Rastogi Publications (India), ISBN: 978-93-5078-140-1.


12/6/2019



SEMESTER-III

Course title: Biostatistics and Bioinformatics

Course code: SIAL SC 1 3 12 C 4004

Credit: 4

Lectures: 60

Course objective: To introduce the students in the field of bioinformatics and enables them to understand the concepts of statistics in biology.

Learning outcomes:

- Understanding statistical analysis of biological data
- Understanding the role of computer science in predicting structure and function of biomolecules
- Understanding similarities and differences among living organisms on the basis of genetic information

Unit-I

Definition of selected terms scale of measurements related to statistics; Methods of collecting data, Presentation of data statistical Tables, Need for reduction of data measures of averages and location, Measures of dispersion: Range, quartile deviation, mean deviation and relative deviation. Probability: basic concepts; basic theorems of probability addition and multiplication theorems; conditional probability of Bayes Theorems. Probability mass function, probability density function, cumulative distribution function.

Unit-II

Probability distribution definition and applications; Binominal distribution, Poisson distribution, Normal distribution, logic of statistical standard error estimation testing of hypothesis. Tests of significance: Null hypothesis, alternative hypothesis, type I error, type II error, level of significance, and power of test. Tests for mean based on normal distribution, one sample t-test, two-sample t-test, paired-sample t-test, Chi-Squared test, and Tests for variance based on normal distribution – one sample and two-sample problem. One-way and Two-way analysis of variance (ANOVA) techniques. Correlation concept and applications, Spearman's rank correlation coefficient, regression concept and applications.

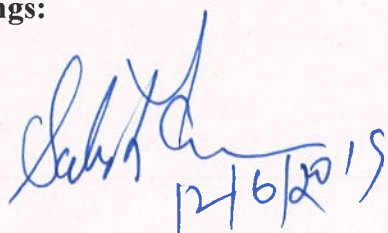
Unit-III

Historical background. Scope of bioinformatics - genomics, proteomics, computer aided drug design (structure based and ligand based approaches), Applications of bioinformatics. Introduction to biological databases - primary, secondary and composite databases, Different formats of molecular biology data. NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB)

Unit-IV

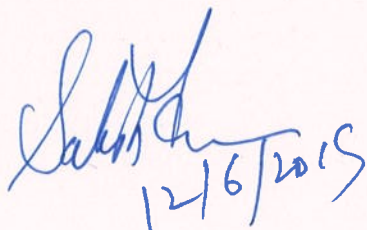
Similarity, identity and homology. Alignment-local and global alignment, pairwise and multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTAL omega. Identification of open reading frames (ORF), Concept of orthology, paralogy and homology in gene and protein sequences. Methods and tools for phylogenetic analysis, maximum parsimony, maximum likelihood and distance methods; creation, evaluation and interpretation of evolutionary trees phylogenetic tree.

Suggested Readings:


12/6/2015



1. Fundamentals of Statistics (2016) Goon, AM, Gupta, MK and Dasgupta, B. Vol. I & II. World Press, ASIN: B01LB7MH74.
2. Statistical Methods (2012) 1st ed., Das, NG. Vol I & II. Tata McGraw Hill, ISBN: 9780070263512.
3. Probability and Statistics for Engineers and Scientists (2013) 9th ed., Walpole, RE, Myers, RH, Myers, SL and Ye, Pearson Education India KE ISBN: 978-9332519084.
4. Biostatistics: A Foundation. for Analysis in the Health Sciences (2012) 10th ed., Daniel, WW and Cross, CL. John Wiley & Sons, ISBN: 978-1118302798.
5. Essential Bioinformatics (2006) 1st ed., Xiong J, Cambridge University Press, ISBN: 978-0521600828.
6. Fundamental concepts of Bioinformatics (2003) Krane DE and Raymer ML Pearson, ISBN: 978-8177587579.
7. An Introduction to Bioinformatics (2017) 1st ed., Knight R, Larsen and Keller Education, ISBN: 978-1635490459.
8. Concepts of Bioinformatics and Genomics (2016) 1st ed., Momand J, McCardy A, Heubah, S and Warter-Perez N, Oxford University Press, ISBN: 978-0199936991.


12/6/2015



SEMESTER-III

Course title: Microbial Genetics and Genomics

Course code: SIAL MB 1 3 05 C 4004

Credit: 4

Lectures: 60

Course objectives: This course is designed to provide a comprehensive details on microbial genomes, their regulatory and transfer mechanisms.

Learning outcomes:

- Understanding the structure and functions of genomes of different microbial groups
- Understanding the processes behind mutations and other genetic changes
- Identifying and distinguishing genetic regulatory mechanisms at different levels

Unit-I

Molecular basis of mutations - induced *versus* spontaneous mutations; gene mapping by recombination and complementation; fine gene structure analysis; cloning genes by complementation and marker rescue; DNA repair mechanisms; mutation and microbial evolution.

Unit-II

Gene transfer in bacteria - conjugation, transformation and transduction; Regulation of gene transfer by conjugation; Mapping the bacterial genomes using Hfr strains; transfer systems in gram positive bacteria; Ti plasmid and applications; transformation - molecular basis of natural transformation; transduction- generalized *versus* specialized transduction; mapping bacterial genes by transduction; tetrad analysis in fungi; positive and negative gene regulation and attenuation in different operons; riboswitches.

Unit-III

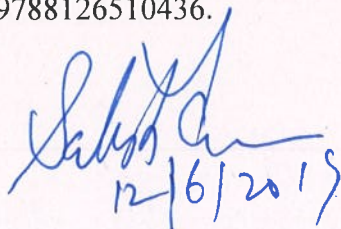
Genes involved in the lytic and lysogenic cycle of lambda phage; Replication and packaging of filamentous phages M13; Benzer's experiments to construct phage genetic linkage maps; Transposons and gene regulation; Yeast Ty -1 transposon; methods of gene cloning and sequencing; genome transplantation (Synthetic genome).

Unit-IV

Sequencing of microbial genomes; database of microbial genomes; understanding microbial genomes; house keeping genes, essential genes; cluster of orthologous genes; minimal genome; microbiome analysis through genetic tools; metagenome and advances of metagenomics; application of crispr-cas9 system based genome editing.

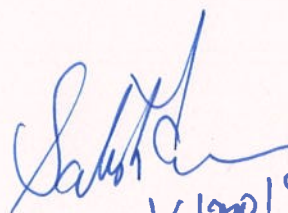
Suggested readings:

1. Lewin's GENES XII (2017) 12th ed. Krebs JE, Elliott S and Goldstein. Jones and Bartlett Publishers. ISBN: 9781284104493.
2. Concepts of Genetics (2016) 10th ed. Klug, Cummings and Spencer. Pearson Education India. ISBN: 9332577463.
3. Molecular Genetics of Bacteria (2013) 4th ed. Snyder L, Peters, Henkin and Champness... ASM Press; ISBN: 9781555816278.
4. Principles of Genetics (2010) 8thed. Gardner, Simmons and Snustad, Wiley India Pvt Ltd ISBN: 9788126510436.


12/6/2019



5. Mining of Microbial Wealth and MetaGenomics (2017) 1st ed. Kalia VC, Shouche Y, Purohit HJ and Rahi P. Springer Nature Singapore Pte Ltd. ISBN: 9789811057076.
6. Microbial Diversity in the Genomic Era (2018) 1st ed. Das S and Dash HR. Academic Press, ISBN: 9780128148495.


12/6/2019



SEMESTER-III

Course title: Industrial Microbiology
Course code: SIAL MB 1 3 06 C 4004

Credit: 4
Lectures: 60

Course objectives: To familiarize about principles of fermentation, fermentation equipment and their control and applications of microbes and their improvement for commercial production of valuable products.

Learning outcomes:

- Know-how of the industrial microbes and their improvement strategies
- Understanding the concepts and practices of industrial fermentation processes
- Understanding of applications of microorganisms in different industrial sectors

Unit-I

History of fermentation and Industrial Microbiology; Scope of Industrial Microbiology; Definition, types and examples of fermentation processes. Industrially important microorganisms- their characteristics, Screening and selection, biology and metabolism. Maintenance and Preservation of Industrial Strains, Microbial Culture collections. Microbial Strain Improvement- mutagenesis, protoplast fusion and genome shuffling, parasexual reproduction and recombinant DNA approach.

Unit-II

Fermentation media used in industrial fermentations - characteristic features of substrates and nutrients; formulation and optimization of media for industrial fermentations, media sterilization. Inoculum development. Kinetics of substrate utilization, biomass production and product formation in batch, fed-batch and continuous cultivations. Characteristics of solid substrate and submerged fermentations.

Unit-III

Laboratory fermenter – design and types (stirred tank reactor, bubble column reactor, airlift reactor, packed bed reactor, fluidized bed reactor), solid state reactors. Instrumentation and control of bioprocesses. Scale-up and scale-down principles. Downstream processes for product recovery (cell disruption, precipitation, filtration, centrifugation, extraction, chromatography, membrane process, drying, crystallization, packaging). Fermentation process economics.

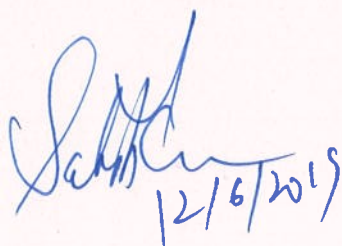
Unit-IV

Types of microbial products; production of microbial biomass -baker's yeast, mushroom and single cell proteins, biofertilizers, biopesticides. production of primary metabolites -ethanol, organic acids (citric acid and lactic acid), amino acids (glutamic acid, lysine), vitamins (vit b₂ and vit b₁₂), nucleotides, industrial enzymes (amylases, proteases, streptokinases, tyrosinase), production of secondary metabolites - antibiotics (penicillin, cephalosporins, streptomycin), pigments. Designer's microbes for health, food and energy applications. Production of metabolites of non-microbial origin (insulin, interleukins, cytokines). Fermentative production of probiotics and prebiotics. Microbial transformations.

Suggested readings:

1. Industrial Microbiology (2016), 2nd ed., Casida, LEJR, New Age International (P) Ltd., New Delhi, India., ISBN: 9788122438024.

2. Modern Industrial Microbiology and Biotechnology (2017), 2nd ed., Okafor N and Okeke, BC, CRC Press, ISBN: 9781138550186.
3. Biotechnology: A Test Book of Industrial Microbiology (2017) 2nd ed., Crueger W, Crueger A and Aneja KR, Panima Publishing corporation (New Delhi), ISBN: 9789385998638.
4. Manual of Industrial Microbiology and Biotechnology (2010), 3rd ed., Baltz RH, Demain AL, Davies JE, ASM Press, ISBN-13: 978-1555815127.
5. Industrial Microbiology (2015), 2nd ed., Patel AH, Laxmi Publications (P) Ltd. (New Delhi), ISBN-13: 9789385750267.
6. Principles of Fermentation Technology (2016), 3rd ed. Stanbury PF, Whitaker A and Hall SJ, Butterworth-Heinemann, eBook ISBN: 9780444634085, Paperback ISBN: 9780080999531.


12/6/2019



SEMESTER-III

Course title: Medical Microbiology and Virology

Course code: SIAL MB 1 3 07 C 4004

Credit: 4

Lectures: 60

Course objectives: An advanced understanding and applied knowledge in the theory and practice of recent advances and research methodology related to infectious diseases of Humans, Plants and Animals.

Learning outcomes:

- Understanding the role of native microbial flora of human body
- Understanding microbial virulence mechanisms
- Demonstrations of techniques and antimicrobial used to identify the cause and to treat infections

Unit-I

Normal microflora of the human body and its importance: normal microflora of skin, throat and gastrointestinal tract; Collection, transport and culturing of clinical samples (sputum, urine, blood, stools) for microbiological analysis; Human microbiome.

Unit-II

Causative agents, symptoms, mode of transmission and control of diseases caused by *Staphylococcus aureus*, *Streptococcus pyogenes*, *Haemophilus influenzae*, *Mycobacterium tuberculosis*, *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Helicobacter pylori*, *Bacillus anthracis*, *Clostridium tetani*, *Treponema pallidum* and torch group of pathogens; causative agents, symptoms, mode of transmission and control of diseases dermatomycoses, histoplasmosis, candidiasis, malaria and kala-azar; mechanism of action of various antimicrobial agents - inhibitors of nucleic acid synthesis, cell wall synthesis, cell membrane function and protein synthesis.

Unit-III

Concept of early and late proteins; regulation of transcription in lambda phage; salient features of viral nucleic acid - unusual bases (TMV, T4 phage), overlapping genes (ϕ X174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (Lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (Retrovirus), segmented genomes (Influenza virus), non-segmented genomes (Picornavirus), capping and tailing (TMV); modes of transmission of plant and animal viruses; viral multiplication and replication strategies: interaction of viruses with cellular receptors an entry of viruses; replication of viruses as per Baltimore classification - assembly, maturation and release of virions.


Unit-IV

Causative agents, symptoms, mode of transmission and control of disease caused by human, animal and plant viruses – polio, influenza, rabies, common cold, aids, hepatitis, chikungunya, dengue, ebola, foot and mouth disease, blue tongue disease, mad cow disease, bud necrosis, tobacco mosaic disease and cauliflower mosaic disease; introduction to oncogenic viruses; types of oncogenic DNA and RNA viruses; mechanism of disease causation by plant viruses; antiviral compounds and their mode of action; interferon and their mode of action; use of viral vectors in cloning, expression, and gene therapy.

Suggested Reading:

1. Medical Microbiology (2015) 8th ed. Patrick R, Murray, Ken S, Rosenthal P, Elsevier Press, ISBN: 9780323299565.

2. Medical Microbiology (2016) 27th ed. Carrol KC, Morse SA, Mietzner T and Miller S. Jawetz, Melnick, & Adelberg's. McGraw-Hill Education, ISBN: 9780071824989
3. Sherris Medical Microbiology (2018) 7th ed. Ryan K, Ahmad N, Alspaugh JA, Drew JL, Lagunoff M, Pottinger P, Reller LB, Reller M, Sterling and Weissman S. McGraw-Hill Education, ISBN: 9781259859809.
4. Virology: Principles and Applications (2013) 2nd ed. Carter J, Saunders V, Wiley & sons, ISBN: 9781119991427.
5. A Textbook Of Veterinary Special Pathology Infectious Diseases Of Livestock And Poultry (2015) 1st ed: Vegad J L Katiyar A K, CBS Publisher ISBN: 9788123927886.


12/16/2013



SEMESTER-III

Course title: Practical-III

Course code: SIAL MB 1 3 08 C 0084

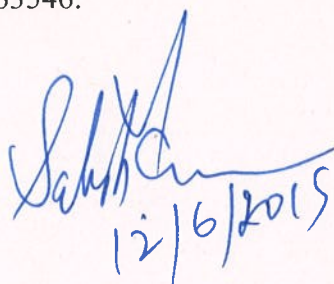
Credit: 4

Lectures: 120

1. Study of resident microflora of the skin;
2. Identification of pathogens using biochemical assays
3. Identification of specific pathogens using kits (eg. Widal Test);
4. Antibiotic susceptibility testing using Kirby-Bauer method;
5. Determination of minimal inhibitory concentration (MIC) of an antibiotic using double dilution technique or E-test strips.
6. Isolation of industrially important microorganism from different sources
7. Determination of yield coefficient of *Saccharomyces cerevisiae* on various substrates
8. To study the design of fermenter and its working;
9. Production of ethanol using different substrates by yeast
10. Production of extracellular enzymes submerged and solid state conditions;
11. Isolation of genomic DNA and RNA from bacteria;
12. Isolation of plasmid DNA from bacterial culture;
13. Transformation experiment in *E.coli* by chemical method and electroporation and determination of transformation efficiency;
14. Designing and amplification of gene of interest by Polymerase Chain Reaction
15. Isolation, characterization of bacteria fungi present in cultivated and diseased plants
16. To study occurrence of disease by inoculation with bacterial or fungal pathogens
17. Measuring plant disease intensity under controlled conditions;
18. Biochemical and physiological tests for detection of pathogens in fruits and vegetables;
19. Determination of microbial interactions such as antagonism and symbiosis
20. Calculations on the diversity indices to determine microbial diversity,
21. Demonstrations on phylogenetic analysis of microorganisms

Suggested Readings:

1. Microbiology: A laboratory Manual. (2017) 11th ed. Cappuccino JG, Welsh C. Pearson Education, Inc. ISBN: 9780134098630.
2. Laboratory Manual of Microbiology and Biotechnology (2014) 1st ed. Aneja KR, Scientific International Pvt. Ltd., ISBN: 9789381714553.
3. Laboratory Manual and Workbook in Microbiology: Applications to Patient Care (2003) 7th ed. Morello JA, Helen PA and Mizer E, McGraw Hill Publications ISBN: 0072463546.


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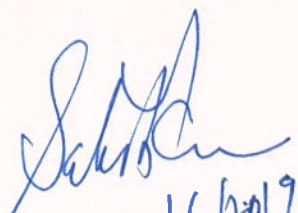
SEMESTER - III

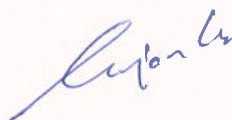
Course title: Seminar

Credit: 2

Course code: SIAL MB 1 3 09 C 0202

Seminar will be of 45-minute duration during which the presentation will be followed by questions session by the audience comprising of faculty and students. Every student shall be required to submit the topic of his/her seminar in consultation with the Head of the Department/Faculty members/student advisors well in advance so that the same may be displayed on the notice board. The presenter has to write an Abstract to be distributed during Seminar in addition to two copies of write-up giving relevant details of the background of the subject, methods used and references/List of sources from where the material for presentation has been collected.


12/6/2019



SEMESTER - III

Course title: Microbial Ecology

Course code: SIAL MB 1 3 03 DCEC 4004

Credit: 4

Lectures: 60

Course objectives: To understand the habitats, diversity and role of microbial communities in different environment and to demonstrate the modern approaches to detect the diversity of microbial communities.

Learning outcomes:

- Understanding the interactions determining the development of microbial communities
- Basic knowledge for analyzing microbial ecosystems; both natural and artificial systems
- Demonstrating the role of microbial niches in different applications

Unit-I

The general principals of microbial behaviour in ecosystems. Microbial evolution and biodiversity of different microbial groups. Natural microbial ecosystems (terrestrial, deep surface, fresh water, lake and river, marine and hydrothermal vents) artificial microbial ecosystems (biological water purification systems, anaerobic digestion, gut simulation models).

Unit-II

Microbial interactions related to resource competition and predation, parasitism. Interactions among microbes, plant microbe interactions, animal-microbe interactions, syntrophy, consortia and biofilms, quorum sensing.

Unit-III

community structure and energetics, species, diversity and indices, maintenance of species diversity, origin and maintenance of communities, collection of ecological samples for community analysis, molecular techniques and microbial community ecology, methods based on DNA/RNA, Methods based on fatty acids or lipids, methods based on function/physiology.

Unit-IV

Role of microorganisms in biogeochemical cycles, biodegradation, bioremediation, biomineralization and biocontrol.

Suggested readings:

1. Environmental Microbiology and Microbial Ecology (2019) 2nded. Barton LL, McLean RJC. John Wiley & Sons, ISBN: 9781118966266.
2. An Introduction to Microbiology (2019), 3rded., Tauro P, Kapoor KK, Yadav KS, and Sequeira MG. New Age International Publishers. ISBN: 0852268785
3. Principles of Microbial Diversity (2015), Brown JW, ASM Press, Washington DC, ISBN-10: 9781555814427.
4. Microbial Ecology: Fundamentals and Applications (2008). 4thed. Atlas RM and Bartha R. Pearson Publications. ISBN: 9780805306552.
5. Soil Microbiology, Ecology and Biochemistry (2015) 4thed. Paul EA. Elsevier Inc. ISBN: 9780124159556.
6. Microbial Diversity in the Genomic Era (2018) 1st ed., Das S and Dash H, Academic Press, ISBN: 978012814850.

SEMESTER - III

Course title: Plant Pathology

Course code: SIAL MB 1 3 04 DCEC 4004

Credit: 4

Lectures: 60

Course objective: To appraise the students about principles plant pathology and measure of diseases of agricultural crops.

Learning Outcomes:

- Understanding of factors responsible for diseases in the crops
- Determining the mechanisms of pathogens for causing diseases in plants
- Demonstrating the techniques for management of crop diseases

Unit-I

Introduction and history of plant pathology; definitions and concepts of plant diseases; biotic and abiotic factors responsible for plant diseases; Interaction of microorganisms with plants and their effect on plant growth.

Unit-II

Growth, reproduction, survival and dispersal of important plant pathogens; Production of various enzymes, toxins and other metabolites by pathogens for causing disease; Role of environment and host nutrition on disease development; diseases of some important cereals (Rice, wheat), vegetables (Tomato, Potato), commercial crops (Cotton, Sugarcane) and fruit crops (Mango, Citrus, Grapes).

Unit-III

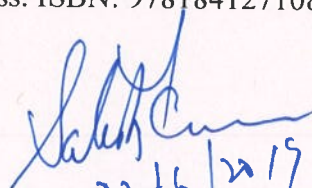
Host-pathogen interactions - recognition and infection, symptomatology, disease development- role of enzymes, toxins, growth regulators; defense strategies; hypersensitivity responses including oxidative burst, phenolics, phytoalexins, PR proteins, elicitors and their effects on host plants.

Unit-IV

Plant disease resistance – pathogen associated molecular patterns, pattern recognition receptors, PTI, effectors, ETI, 'R' genes; mechanism of genetic variation in pathogens; disease control in plants - physical, chemical methods; use of biocontrol agents - bacteria and fungi; Transgenic approach for plant protection - applications and constraints.

Suggested readings:

1. Introduction to Principles of Plant Pathology (2018) 5thed. Singh RS, Scientific International Pvt. Ltd. ISBN: 9739386479488.
2. Plant Pathology (2018) 1sted., Burchett, S and Burchett S CRC Press, ISBN: 9780815344834.
3. Principles of Plant Pathology (2014) Jagtap G, Dhutraj D and Dey U. Agrobios (India), ISBN-978-8177544916.
4. Plant Pathology, (2005) 5thed., Agrios GN, Academic Press (New York) ISBN: 9780120445653.
5. Molecular Plant Pathology (2003) 1st ed., Dickinson M, Sheffield Annual Plant Reviews, CRC Press. ISBN: 9781841271088.


12/6/2019



SEMESTER - III

Course title: Applied Microbiology
Course code: SIAL MB 1 3 03 GEC 4004

Credit: 4
Lectures: 60

Course objective: To understand the role of microorganisms and microbial processes in welfare of humankind and too correlate the traditional microbiological techniques to microbial applications and their control.

Learning outcomes:

- Understanding of basic applications of microorganisms
- Know-how of the beneficial and harmful roles played by microbes
- Understanding of the roles of microbes in medical, environmental, industrial and food processes

Unit-I

History, applications and scope of microbiology- introduction to microscopic and pure culture techniques, microbial cell structure and functions, Microbial Growth and Control, balanced and unbalanced growth, growth curve.

Unit-II

Microbial Interactions with humans –normal microflora of human body, nosocomial infections, some common examples of food, air, water borne diseases, and their causative agents, antibiotics and Vaccines; Introduction to immunodiagnosics – RIA, ELISA.

Unit-III

Role of microorganisms in environment and agriculture, biogeochemical cycles (N, C, P), plant growth promoting bacteria, beneficial associations and interactions of microbes with microbe themselves, plant and animals, biodegradation, biodeterioration, biomineralization, bioremediation.

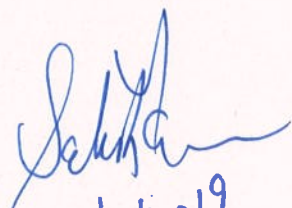
Unit-IV

Industrial and food applications of microbes, food fermentations (sauerkraut, tofu, tempeh, cheese, fermented milk), starter cultures, probiotics and prebiotics, industrial production of microbial biomass (baker yeast and SCP), primary (alcohol, vitamins and enzymes) and secondary metabolites (antibiotics).

Suggested readings:

1. Kuby Immunology (2018) 8th ed., Punt J, Stranford S, Jones P and Owen JA, W.H Freeman and Company, ISBN: 978-1319114701.
2. Manual of Environmental Microbiology (2016) 4th ed., Yates MV, Nakatsu CH, Miller, RV and Pillai RV, ASM Press (USA), Print ISBN: 9781555816025, e-ISBN : 9781555818821.
3. Environmental Microbiology: Fundamentals and Applications (2015) 1st ed., Bertrand, JC, Caumette P, Lebaron P, Matheron R, Normand P and Sime-Ngando T, Springer Netherlands, eBook ISBN: 978-94-017-9118-2, Hardcover ISBN: 978-94-017-9117-5.
4. Environmental Microbiology (2016-17) 1st ed., Sharma, PD, Rastogi Publications (India), ISBN: 978-93-5078-140-1.
5. Industrial Microbiology (2016) 2nd ed., Casida LEJR, New Age International (P) Ltd., New Delhi, India., ISBN: 9788122438024.

6. Modern Industrial Microbiology and Biotechnology (2017) 2nd ed., Okafor N and Okeke, BC, CRC Press, ISBN: 9781138550186.
7. Biotechnology: A Test Book of Industrial Microbiology (2017) 2nd ed., Crueger W, Crueger A and Aneja KR, Panima Publishing corporation (New Delhi), ISBN: 9789385998638.


12/6/2019



SEMESTER - III

Course title: Microbes and Diseases
Course code: SIAL MB 1 3 04 GEC 4004

Credit: 4
Lectures: 60

Course objectives: The course is designed to provide a comprehensive details on different infectious agents and their implications.

Learning outcomes:

- Fundamental understanding of ecological factors that affect the transmission of infectious diseases
- Understanding the virulent determinants and social implications of infectious agents

Unit-I

Bacterial Pathogenesis: Types of Bacterial Pathogens (Primary Pathogens; Opportunistic Pathogens); Pathogen Classification (BSL-1-4); Pathogenicity; Virulence factor; Transmission of Pathogens (Aerosol, Oral, Direct contact, Fomite, Vector-borne, Zoonoses); Koch's Postulates (Modified).

Unit-II

Penetration of Host Defenses: Capsules; Cell Wall Components; Enzymes, (Exoenzymes, Coagulases, Kinases, Hyaluronidase, Collagenase, IgA proteases); Antigenic Variation. Penetration into Host Cytoskeleton: Invasins, Cadherin Damage to Host Cells: Using Hosts Nutrients, Direct Damage to Colonized Area, Production of Toxins (Exotoxins, Endotoxins) Bacterial Secretion System.

Unit-III

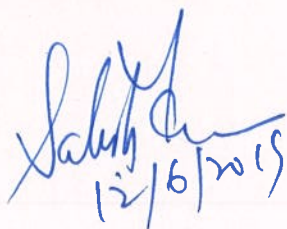
Regulation of Virulence Factors: Sigma Factors, Two Component System, Evolution of Bacterial Pathogens: Horizontal Gene Transfer, Pathogenicity Island, Antibiotic Resistance, Plasmids, Lysogeny and Pathogenicity, Pathogenic Properties of Virus, Eukaryotic Pathogens (Fungi; Protozoa; Algae).

Unit-IV

Microbes and Human Life: Medical and Pharmaceutical benefits of Microbes; Emerging and Reemerging Infectious Diseases; Bioterrorism.

Suggested readings:

1. Basic Medical Microbiology (2017) 1st ed. Murray PR. Elsevier. ISBN: 978032347676
2. Medical Microbiology (2016) 27th ed. Carrol KC, Morse SA, Mietzner T and Miller S. Jawetz, Melnick, & Adelberg's.. McGraw-Hill Education. ISBN: 9780071824989
3. Sherris Medical Microbiology (2018) 7th ed. Ryan K, Ahmad N, Alspaugh JA, Drew JL, Lagunoff M, Pottinger P, Reller LB, Reller M, Sterling C, Weissman S. McGraw-Hill Education. ISBN: 9781259859809
4. Kuby Immunology (2007) 6th ed. Kindt, Thomas J., Goldsby, Richard A. and Osborne, Barbara A. W.H. Freeman and Co. Publishers.
5. Textbook of Microbiology (2017) 10th ed. Ananthanaryan and Paniker, Universities Press, ISBN: 9789386235251


12/6/2015



SEMESTER-IV

Course title: Dissertation

Credit: 20

Course code: SIAL BT 1 4 01 SEEC 0020

Guidelines for Project File

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The file is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated goals.
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen that may be useful to document for future reference.
- The guidelines and format for dissertation is given below:

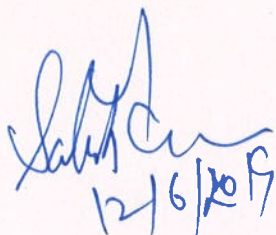
Dissertation Guidelines

1. GENERAL :

The manual is intended to provide broad guidelines to the M.Sc. candidates in the preparation of the dissertation report. In general, the project report shall report, in an organised and scholarly fashion an account of original research work of the candidate leading to the discovery of new facts or techniques or correlation of facts already known.

2. NUMBER OF COPIES TO BE SUBMITTED:

Students should submit three copies to the Head of the Department concerned on or before the specified date.


12/6/2019



3. ARRANGEMENT OF CONTENTS OF DISSERTATION

Dissertation material should be arranged as follows:

1. Cover Page & Title page
2. Declaration
3. Certificate
4. Abstract (Hindi and English)
5. Acknowledgements
6. Table of Contents
7. List of Tables
8. List of Figures
9. List of Symbols, Abbreviations and Nomenclature (Optional)
10. Chapters
11. References
12. Appendices
13. One page CV

The Tables and Figures shall be introduced in the appropriate places.

4. PAGE DIMENSIONS AND MARGIN:

The dimensions of the dissertations should be standard A4 size paper may be used for preparing the copies, **standard margin** with 1.5 line spacing.

5. MANUSCRIPT PREPARATION:

The general text of thesis shall be typed in font style Times New Roman and font size 12. Same quality of paper should be used for the preparation of the entire report/thesis; except figure, photos are shown.

- 5.1 **Cover Page & Title Page** - A specimen copy of the Cover page & Title page for report/thesis are given in Annexure I.
- 5.2 **Certificate**-The Bonafide Certificate as per the format shown in Annexure II
- 5.3 **Abstract**: Abstract should be an essay type (HINDI and ENGLISH) of narration not exceeding 500 words outlining the research problem, the methodology used for tackling it and a summary of the findings, typed in 1.5 line spacing.
- 5.4 **Acknowledgements**: The acknowledgements shall be brief and should not exceed one page. The student's signature shall be made at the right bottom above his / her name typed in capitals.
- 5.5 **Table of contents** - The table of contents should list all material following it as well as any material which precedes it. The title page, Bonafide Certificate and Acknowledgment will not find a place among the items listed in the Table of Contents but the page numbers in lower case Roman letters are to be accounted for them. One and a half spacing should be adopted for typing the matter under this head. A specimen copy of the Table of Contents for report / thesis is given in Annexure III.
- 5.6 **List of Table** - The list should use exactly the same captions as they appear above the tables in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head.
- 5.7 **List of Figures** - The list should use exactly the same captions as they appear below the figures in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head

5.8 List of Symbols, Abbreviations and Nomenclature - One and a half spacing should be adopted for typing the matter under this head. Standard symbols, abbreviations etc. should be used.

5.9 Chapters - The chapters may include

Chapter I – Introduction

Chapter II - Literature Review

Chapter III –Materials and Methods

Chapter IV- Results and Discussion

1.10. Research output/outcome if any published or presented in conference/seminar/symposium may be included.

1.11. List of References - Any works of other researchers, if used either directly or indirectly, should be indicated at appropriate places in the report/thesis. The citation may assume any one of the following forms. **APA Style.**

APA in-text citation style uses the author's last name and the year of publication, for example: (Field, 2005).

Example:

Derwing, T. M., Rossiter, M. J., & Munro, M. J. (2002). Teaching native speakers to listen to foreign-accented speech. *Journal of Multilingual and Multicultural Development*, 23(4), 245-259.

Thomas, H. K. (2004). *Training strategies for improving listeners' comprehension of foreign-accented speech* (Doctoral dissertation). University of Colorado, Boulder.

6. TYPING INSTRUCTIONS

6.1 General

This section includes additional information for final typing of the thesis. Some information given earlier under 'Manuscript preparation' shall also be referred. The impressions on the typed/duplicated/printed copies should be black in colour. Corrections, interlineations and crossing out of letters or words will not be permitted in any of the copies of the report/thesis intended for submission. Erasures, if made, should be neatly carried out in all copies. A sub-heading at the bottom of a page must have at least two full lines below it or else it should be carried over to the next page. The last word of any page should not be split using a hyphen. One and a half spacing should be used for typing the general text. The general text shall be typed in Font Style Times New Roman and Font Size 12.

Single spacing should be used for typing:

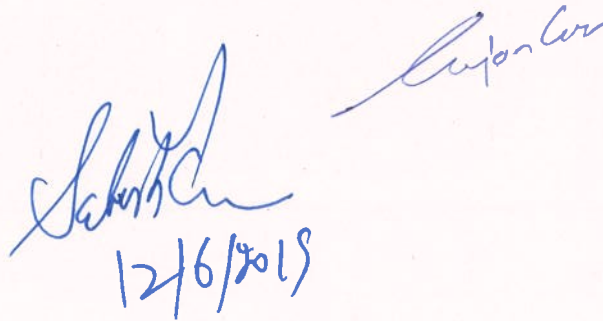
- (i) Long Tables
- (ii) Long quotations
- (iii) Foot notes
- (iv) Multilane captions
- (v) References

Signature
12/6/2019

6.2 Chapters The format for typing chapter headings, division headings and sub division headings shall be same as given in Table of Contents.

7. BINDING SPECIFICATIONS

Thesis should be spiral or soft cover book bound, the cover of thesis should be of dark greencolor, printed with golden ink and the text for printing should be identical as prescribed for the title page.

Handwritten signature and date in blue ink. The signature is stylized and appears to be 'Sahib' followed by a flourish. Below the signature is the date '12/6/2019'. To the right of the signature is another handwritten mark that looks like 'Lupor' followed by a flourish.

APPENDIX I A: (A typical Specimen of Cover Page & Title Page—DISSERTATION REPORT)

TITLE OF DISSERTATION REPORT

<1.5 line spacing>



DISSERTATION

Submitted by

<Italic>

NAME OF THE CANDIDATE

Under the Supervision of

NAME OF THE SUPERVISOR

in partial fulfillment for the award of the degree of

<1.5 line spacing>

MASTERS OF SCIENCE IN

NAME OF THE PROGRAMME

DEPARTMENT OF

SCHOOL OF

CENTRAL UNIVERSITY OF HARYANA,

MAHENDERGARH-HARYANA

<1.5 line spacing>

MONTH AND YEAR

Submitted by
12/6/2019

Supervisor

DECLARATION

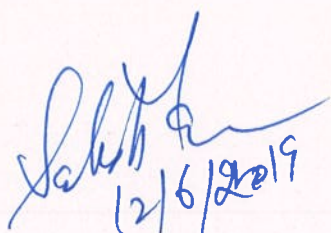
I, student of the School of Interdisciplinary and Life Sciences, Central University of Haryana, Mahendergarh hereby declare and certify with my signature that my thesis entitled

..... submitted to the Department of, Central University of Haryana, India in partial fulfillment of the requirements for the award of the Degree of Masters of Science is a record of original research work done by me and the dissertation has not been the basis for the award of any degree/diploma/associateship/fellowship or similar title of any candidate of any University. I have faithfully and accurately cited all my sources, including books, journals, handouts and unpublished manuscripts, as well as any other media, such as the Internet, letters or significant personal communications.

I understand the concept of "plagiarism" and declare that while drafting this dissertation I have refrained from plagiarism. I know that plagiarism not only includes direct copying, but also the extensive use of other's ideas without proper referencing or acknowledgement (which includes the proper use of references and quotation marks).

If my dissertation found to be plagiarized at any point of time, I'll be solely responsible and will be ready to accept any decision taken by the competent authority including rejection of my dissertation.

(Signature of student)


12/6/2019



APPENDIX – I B: (A typical Specimen of Certificate)

Font Style <Times New Roman >

CENTRAL UNIVERSITY OF HARYANA

CERTIFICATE

This is to certify that the dissertation entitled “**TITLE OF THE DISSERTATION**”, submitted to the Department of, Central University of Haryana, India in partial fulfillment of the requirements for the award of the Degree of Masters of Science in is a record of original research work done by **NAME OF THE CANDIDATE (Roll No.....)**. in the..... (Place of research) under my guidance. It is further certified that to the best of our knowledge the dissertation has not been the basis for the award of any degree/diploma/associateship/fellowship or similar title of any candidate of any University so far.

<<Signature of the Supervisor with date>>

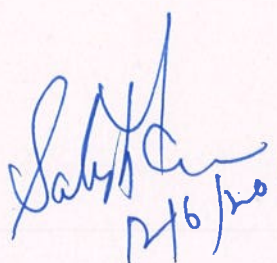

<<Name of the Supervisor >>

<<Academic Designation of Supervisor>>

<<Name of Division/Centre>>

Central University of Haryana

Mahendergarh-123031


24/6/2015 

For example

(A typical Specimen of Table of Contents)

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	iii
	LIST OF TABLES	xvi
	LIST OF FIGURES	xviii
	LIST OF SYMBOLS, ABBREVIATIONS	xxvii
1	INTRODUCTION	1
	1.1 GENERAL	1
	1.2 NEED FOR THE STUDY	2
	1.3 OBJECTIVES OF THE STUDY	3
2	REVIEW OF LITERATURE	4
	2.1 INTRODUCTION	4
	2.2	4
	2.2.1 Product	6
	2.2.2 Product....	6

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12/6/2019

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ANNEXURE II

Curriculum vitae

Personal Details

Name :

Date of birth : DD Month, YYYY

Place of birth :

Nationality : Indian

Permanent Address :

Email Id :

Mobile No. :

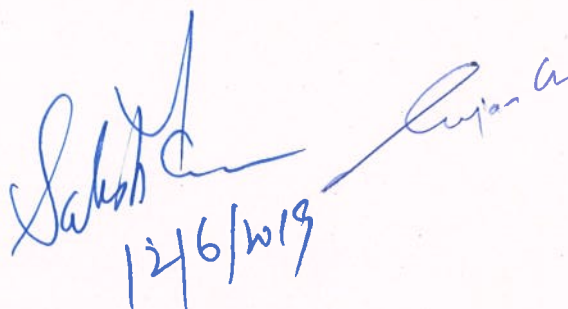
Education

M.Sc. (Subject) : YYYY Central University of Haryana, India

B.Sc. (Subject). : YYYY (Name of the University) with % of marks

Higher Secondary : YYYY (Name of the board) with % of marks

Secondary : YYYY, (Name of the board) with % of marks

A handwritten signature in blue ink, followed by the date '12/6/2013' written below it. To the right of the date, there is a small handwritten mark that appears to be 'Curian a'.

Minutes of the meeting of Bos

Annexure-IV

A meeting of Board of studies in Department of Biotechnology, C.U.H. Following members were present

1. Prof. Sakish Kumar Convenor (Head of Dept.)
2. Prof. Paramjit Khurana External Expert
3. Dr. Karbyap Kumar Dubey member
4. Dr. Meenu Goyal member
5. Dr. Bijender Singh Special invitee
6. Prof. Neelam Singh Special invitee.

All the agenda items were discussed and resolved as follows:

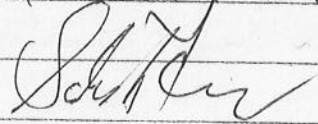
1. The name of paper setters, for the end term examinations of 2nd and 4th semester are recommended subject-wise.
2. The names of external experts of Departmental Research Committee are recommended.
3. The syllabus of M.Sc. (Biotech) is recommended however modified version of scheme/syllabus will be sent again through email to the Bos member for final approval.
4. Minutes of meeting (DRC) held on 15.2.19th recommended.
5. One elective paper in Ph.D. coursework i.e. Genetics of genomics is recommended for next session.
6. Bos members suggested that external examiner for practical exam may not be necessary keeping in view of operational difficulties & proposed that internal faculty may evaluate final practicals.
7. Keeping in view the increased number of students and uniformity across the dissertations undertaken in different labs, it would be prudent to have Board of Examiners (BoE) with 1 or 2 External examiner (outside the dept.) to maintain uniformity across.

[Signatures] P.T.O.

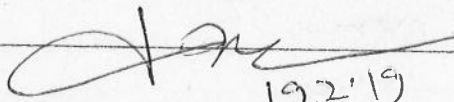
from pre-pages:

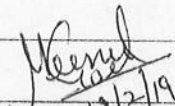
Date _____

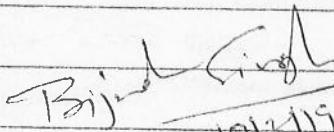
As there was no other item for discussion the meeting ended with the vote of thanks by the chair.

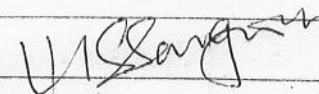

(Prof. Satish Kumar)

Param ^{kh}
19.2.2019
(Prof. Paramjit Khurana)


19.2.19
(Dr. Karthap Kumar Dubey)


19/2/19
(Dr. Meenakshi Goyal)


19/2/19
(Dr. Bijender Singh)
special inviter


(Dr. Neelam Singh Bangar)
special inviter.

School of Interdisciplinary and Applied Life sciences

**Revised Scheme and Syllabi for MSc Biotechnology
(2019-2021)**



**Department of Biotechnology
Central University of Haryana
Mahendergarh**

Department of Biotechnology
Master of Science in Biotechnology (Semester - wise Scheme 2019-2021)

Semester-I (Total credits - 24)

Course code	Course title	L	T	P	Type of course	Credit
SIAL SC 1 1 01 C 3003	Cell and Molecular Biology	3	0	0	Core	3
SIAL SC 1 1 02 C 3003	Principles of Biochemistry	3	0	0	Core	3
SIAL SC 1 1 03 C 3003	General Microbiology	3	0	0	Core	3
SIAL SC 1 1 04 C 3003	Genetics	3	0	0	Core	3
SIAL SC 1 1 05 C 3003	Analytical Techniques	3	0	0	Core	3
SIAL SC 1 1 06 C 00105	Practical-I	0	0	10	Core	5
	General Elective Course (to be opted from other Department)	4	0	0	GEC	4

Semester-II (Total credits - 30)

Course code	Course title	L	T	P	Type of course	Credit
SIAL SC 1 2 07 C 4004	Immunology	4	0	0	Core	4
SIAL SC 1 2 08 C 3003	Biosafety, Bioethics and IPR	3	0	0	Core	3
SIAL SC 1 2 09 C 4004	Genomics and Genetic Engineering	4	0	0	Core	4
SIAL BT 1 2 01 C 4004	Bioprocess Engineering and Technology	4	0	0	Core	4
SIAL BT 1 2 02 C 4004	Cell and Tissue Engineering	4	0	0	Core	4
SIAL BT 1 2 03 C 00105	Practical-II	0	0	10	Core	5
SIAL SC 1 2 10 DCEC 2002	Research Methodology and Scientific Communication Skills*	2	0	0	DCEC	2
SIAL SC 1 2 11 DCEC 2002	Bio-entrepreneurship*	2	0	0	DCEC	2
SIAL BT 1 2 01 DCEC 4004	Pharmaceutical Biotechnology [#]	4	0	0	DCEC	4
SIAL BT 1 2 02 DCEC 4004	Microbial Biotechnology [#]	4	0	0	DCEC	4
SIAL BT 1 2 03 DCEC 4004	Environment Biotechnology [#]	4	0	0	DCEC	4

*One of the courses will be opted by the student.

[#] One of the courses will be opted by the student.

Semester-III (Total credits - 30)

Course code	Course title	L	T	P	Type of course	Credit
SIAL SC 1 3 12 C 4004	Biostatistics and Bioinformatics	4	0	0	Core	4
SIAL SC 1 3 13 C 4004	Biophysics and Nano sciences	4	0	0	Core	4
SIAL BT 1 3 04C 4004	Metabolic Engineering	3	0	0	Core	4
SIAL BT 1 3 05C 4004	Medical Biotechnology and Diagnostics	4	0	0	Core	4
SIAL BT 1 3 06 C 0084	Practical-III	0	0	8	Core	4
SIAL BT 1 3 07 C 0202	Seminar	0	2	0	Core	2
SIAL BT 1 3 04 DCEC 4004	Animal Biotechnology [#]	4	0	0	DCEC	4
SIAL BT 1 3 05 DCEC 4004	Agriculture Biotechnology [#]	4	0	0	DCEC	4
SIAL BT 1 3 06 DCEC 4004	Food Biotechnology [#]	4	0	0	DCEC	4
	General Elective Course (to be opted from other Department)	4	0	0	GEC	4

[#] One of the courses will be opted by the student.

Semester-IV (Total credits - 20)

Skill Enhancement Course

Course code	Course title	Type of course	Credit
SIAL BT 1 4 01 SEEC 0020	Dissertation	Core	20
Total credits of the Program			104

L- Lecture , T- Tutorial P-Practical; C- Core; DCEC - Discipline Centric Elective Course - to be opted by the student; SEEC- Skill Enhancement Course; GEC- General Elective Course.

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Credit Summary of Courses Offered by Department of Biotechnology
(Academic Session 2019-21)

Total Credits: 104

Semester	Credits				Total credits
	Core courses	Skill enhancement course	Elective courses		
			DCEC (For Department of Biotechnology students)	GEC (For other Department students)	
I	20	-	-	4	24
II	24	-	6	-	30
III	22	-	4	4	30
IV	-	20	-	-	20
Total	66	20	10	8	104

Generic Elective Course: Offered by Department of Biotechnology to students from other Departments of University.

Semester	Type of course	Course code	Course title	Credit
I	GEC	SIAL BT 1 1 01 GE 4004	Principles of Biotechnology	4
III	GEC	SIAL BT 1 3 02 GE 4004	Protein Engineering	4

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SEMESTER-I

Course title: Cell and Molecular Biology

Course code: SIAL SC 1 1 01 C 3003

Credit: 3

Lectures: 45

Course objectives: To understand cellular organization and function at molecular level.

Learning Outcomes:

- Understanding of fundamental concepts of cellular and sub-cellular organization
- Molecular basis of genetic information and function

Unit-I

Archea, prokaryotic and eukaryotic cell (animal and plant cells); Theory of origin of eukaryotic cells; Structure and function of nucleus - nuclear envelope, nuclear pore complex; Nuclear protein-import and export, regulation of nuclear protein import and export; Organization of golgi, lysosome, structure and functions of ER, lysosome, mitochondria, chloroplasts and peroxisomes; Fluid mosaic model, membrane proteins, membrane lipids and membrane fluidity; Transport across cell membrane, passive transport, active transport-primary (P-type, F-type, V-type ATPases, ABC transporters), co-transport-symport and antiport; Ion channels, aquaporins, pinocytosis and phagocytosis; Cells as experimental models.

Unit-II

Introduction to cytoskeletal proteins; Organization of cytoskeletal protein and smooth muscle and skeletal muscles, movement of vesicles-role of actin and myosin; Structure of cilia and flagella; Prokaryotic and eukaryotic cell wall, cell matrix proteins; Cell-matrix interactions and cell-cell interactions; Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata; Signalling molecules, receptors and their functions – G protein coupled receptors- Cyclic-AMP, Cyclic-GMP, IP₃, Calcium, Receptor tyrosine kinases - EGF, insulin.

Unit-III

DNA as genetic material, forms of DNA; structure of various type of DNA; chromatin structure; super coiling; polytene and lamp brush chromosomes; properties of DNA in solution; denaturation and renaturation; reassociation reactions; COT curves; types of RNAs and their structures; role of RNA; Unusual bases in RNA; central dogma of molecular biology; DNA polymerases and other enzymes involved in replication; mutagenesis.

Unit-IV

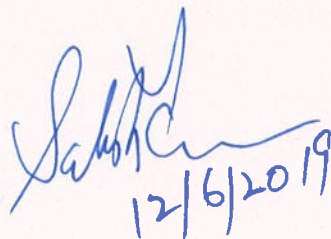
Prokaryotic and eukaryotic gene structure: transcription-RNA polymerase, inhibitors of transcription; proof reading function and fidelity of DNA replication; possible modes of DNA replication; theta model and rolling circle model of DNA replication; replication of DNA in eukaryotes; role of methylation; replication of viral RNA; reverse transcriptase, regulatory region and transcriptional unit of gene; post transcriptional processing of RNA: splicing, cap addition and polyadenylation, polynucleotide phosphorylase.

Suggested readings:

1. The Cell: A Molecular Approach (2018) 8th ed., Cooper, GM, Sinauer Associates is an imprint of Oxford University Press, ISBN: 1605357073.

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2. Molecular Cell Biology (2016) 8th ed., Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D and Darnell J, W.H. Freeman & Company (New York), ISBN: 978-1-4641-0981-2 / ISBN:10: 1464183392.
3. Molecular Biology of the Cell (2008) 6th ed., Alberts B, Johnson A, Lewis J and Enlarge M, Garland Science (Princeton), ISBN: 0-8153-1619-4 / ISBN:0-8153-1620-8.
4. Lehninger Principles of Biochemistry (2017) 7th ed., Nelson DL, Cox MM, W.H. Freeman and Company, New York, USA. ISBN-10: 1-4641-2611-9.
5. Biochemistry (2019) 9th ed., Stryer L, Berg JM, Tymoczko JL, Gatto, Jr. GJ, W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9
6. Genes XII, (2017) 12th Revised edition ed., Lewin B, Krebs J, Kilpatrick ST, Goldstein ES, Jones and Bartlett Publishers, Inc. Sudbury, Massachusetts, USA. ISBN No. 9781284104493.
7. Molecular Biology of the Gene (2013) 7th ed., Watson JD, Baker TA, Bell SP, Gann A, M, Levin RL and Cumming B, San Francisco, ISBN: 0321905377.


12/6/2019

SEMESTER-I

Course title: Principles of Biochemistry

Course code: SIAL SC 1 1 02 C 3003

Credit: 3

Lectures: 45

Course objectives: To understand structures and functions of bio-molecules, metabolic pathways in the living systems.

Learning outcomes:

- Comprehensive knowledge of biochemical pathways-synthesis and catabolism of major biomolecules

Unit-I

Monosaccharides-structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers. Disaccharides: maltose, lactose and sucrose. Polysaccharides: homo and hetero-polysaccharides, structural and storage polysaccharides. Glycolysis - a universal pathway, reactions of glycolysis, production of acetyl CoA, reactions of citric acid cycle. Gluconeogenesis, glycogenesis and glycogenolysis.

Unit-II

Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes-phospholipids, glycerophospholipids, galactolipids, sulpholipids, sphingolipids and sterols. β -oxidation of fatty acids. Fatty acid synthase complex. Synthesis of fatty acids.

Unit-III

Amino acids and peptides- classification (essential and non-essential amino acids), chemical reactions and physical properties. Introduction to protein structure and function. Enzymes: classification, kinetics (significance of k_m , k_{cat} and V_{max}), inhibition; amino acid metabolism-amino acid deamination and transamination, urea cycle. Synthesis and utilization of ketone bodies. Biosynthesis and breakdown of nutritionally non-essential amino acids. Synthesis of other amino acid derivatives such as neurotransmitters.

Unit-IV

Nucleotides - structure and properties. Nucleic acid structure-Watson - Crick Model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. De novo synthesis of purine and pyrimidine nucleotides. Catabolism of purine and pyrimidine. Disorders of purine and pyrimidine metabolism.

Suggested readings:

1. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
2. Biochemistry (2017) 6th ed., Garrett RH and Grisham CM, Brooks/Cole, ISBN: 9781305577206.
3. Harper's Illustrated Biochemistry (2018) 7th ed., Rodwell VW, Bender DA, Botham KM, Kennelly, PJ and Weil PA, McGraw-Hill, ISBN: 9781259837937.
4. Lippincott's Illustrated Reviews Biochemistry (2017) 7th ed., Ferrier, Wolters Kluwer India Pvt. Ltd., ISBN: 978-9351297949.
5. Biochemistry (2019) 9th ed., Stryer L, Berg JM, Tymoczko JL, Gatto Jr. GJ, W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9.

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SEMESTER-I

Course title: General Microbiology
Course code: SIAL SC 1 1 03 C 3003

Credit: 3
Lecture: 45

Course objective: To provide an understanding of basic concepts and techniques in Microbiology.

Learning outcomes:

- Demonstrate the practical skills in basic microbiological techniques
- Designate the role of microorganisms in different ecosystems
- Retrieve and use contemporary information on different microbial groups

Unit-I

History of development of Microbiology in 20th century; The spontaneous generation controversy; Germ theory of disease; Methods in microbiology: Physical and chemical methods of sterilization; Pure culture techniques, maintenance and preservation of microbial cultures.

Unit-II

Binomial nomenclature; Haeckel's three kingdom classification; Organization of archae, bacteria and eukaryotic cell; Use of DNA and r-RNA sequencing in classification of microorganisms; Woese's three kingdom classification system and its utility - archaea, eubacteria, eukarya; Different groups of acellular microorganisms - viruses, viroids and prions.

Unit-III

General features of microorganisms - bacteria, algae, fungi and protozoa; Bacterial growth and metabolism; Microbes in different environment: extreme environment, deep ocean, space and air. Special features of the thermophilic, methanogenic and halophilic bacteria; Photosynthetic bacteria, Cyanobacteria.

Unit-IV

Scope of Microbiology - Cycle of matter in nature; Microbial interactions – Symbiosis and parasitism; Biodegradation and Bioremediation; Biofilms; Microbes in composting; Biofertilizers and Biopesticides; Microbes and Industry - SCP, microbial enzymes and fermented foods, Vaccines and antibiotics.

Suggested readings:

1. An Introduction to Microbiology (2019) 3rded., Tauro P, Kapoor KK, Yadav KS, and Sequeira MG. New Age International Publishers. ISBN: 0852268785.
2. Brock Biology of Microorganisms (2018) 15thed., Madigan MT, Martinko JM, Bender KS, Buckley DH, Stahl DA (Pearson Education, ISBN 9781292235103.
3. Prescott's Microbiology (2017) 10th ed., Sherwood LM, Woolverton C.J McGraw-Hill Education. ISBN 9781259281594.
4. A text book of Microbiology (2013) 3rd ed. Dubey, R.C. and Maheswari, D.K. Revised S. Chand and Company Ltd, New Delhi. ISBN: 9788121926201.
5. Microbiology (2001) 5th ed., Pelczar Jr. M, McGraw Hill Education ISBN: 9780074623206.

SEMESTER-I

Course title: Genetics

Course code: SIAL SC 1 1 04 C 3003

Credit: 3

Lecture: 45

Course objective: To study the fundamental concepts of genetics and its role in unification of different disciplines of biology.

Learning outcomes:

- Understanding of basic concepts of classical genetics and genetic analysis of eukaryotes

Unit-I

Historical background, Principles of Mendelian inheritance, codominance, incomplete dominance, Gene interactions, pleiotropy, Extra chromosomal inheritance: Maternal inheritance (mitochondria and chloroplast), Sex linked inheritance, Sex influenced and Sex limited traits, Gene interactions: Incomplete dominance, codominance, duplicate genes, complementary genes, supplementary genes, lethal genes, pleiotropic genes and multiple alleles.

Unit-II

Linkage: complete and incomplete linkage, linkage analysis and genetic maps, Linkage and recombination of gene, Mechanism of crossing over, Population Genetics and Hardy-Weinberg equilibrium. Genetic analysis: Linkage maps, mapping with molecular markers, Gene mapping by three point test cross, Tetrad analysis, Sex determination and Dosage compensation in Mammals and Drosophila, Quantitative Genetics: Multilocus control; QTL analysis; Quantitative inheritance in plants and human.

Unit-III

Mutations: concept and types, Mechanism of spontaneous mutations, Physical and chemical mutagenesis, Selection and enrichment of mutants, Molecular mechanism of induced mutations, importance of mutation; detection of mutation and directed mutagenesis, Germinal and somatic mutation, insertion, deletion, duplication, translocation, transposition, Numerical alterations of chromosomes: Ploidy and their genetic implications. Types of DNA repair, Molecular mechanism of suppression.

Unit-IV

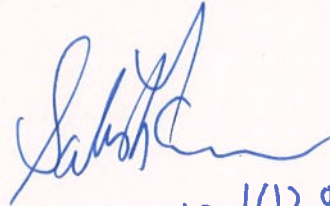
Nucleosome and chromatin structure, Structure of centromere and telomere, Euchromatin and heterochromatin, Polytene and lamp brush chromosomes, Gene transfer in prokaryotes: Transformation, Conjugation and Transduction, Transposons: types, structures and role in gene regulation, Natural and artificial competence, Operon concept in bacteria and gene regulation, Bacterial plasmids, Lytic and lysogenic cell cycles in Phages.

Suggested readings:

1. Principles of Genetics (2006) 8th ed. Gardner EJ, Simmons, MJ and Snustad DP, John Wiley & Sons Inc, ISBN: 8126510439.
2. Essentials of Genetics (2015) 9th ed. William S, Michael K, Cummings R, Spencer, CA and Palladino MA, Prentice Hall Internationals, ISBN-10: 0134047796
3. Genetics (2017) 9th ed. Daniel L. Hartal & B. Cochrane, ISBN: 128412293X
4. Introduction to Quantitative Genetics (1995) Falconer DS, and Mackay TFC, ISBN: 0582243025.

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5. An Introduction to Population Genetics Theory and applications (2013) Nielsen R and Slatkin M, Oxford University Press, ISBN: 1605351539.
6. Evolution 4th ed. (2017) D. Futuma and M. Kirkpatrick, ISBN: 9781605356051
7. An Introduction to Genetic Analysis (2015) Griffith AJFJ, Wessler SR, Carroll SV and Doebley J, ISBN: 0-7167-3520-2.


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SEMESTER-I

Course title: Analytical Techniques
Course code: SIAL SC 1 1 05 C 3003

Credit: 3
Lecture: 45

Course objective: To provide an advanced understanding of the core principles of various techniques used in biological experiments.

Learning outcomes:

- Demonstrate principles of various basic and advanced techniques used in biological experiments
- Critically analyze and interpret the results obtained from biological experiments

Unit-I

Principle of microscopy: resolving powers of different microscopes, magnification; different types of microscopes, principle and applications of compound microscopy, dark microscopy, fluorescence microscopy, phase contrast microscopy, confocal microscopy, atomic force microscopy and electron microscopy (SEM, TEM, STEM); fixation and staining, freeze fracture/etch techniques.

Unit-II

Agarose gel electrophoresis, polyacrylamide gel electrophoresis (native PAGE and SDS-PAGE); Western transfer, iso-electric focusing (IEF), 2-Dimensional gel electrophoresis, pulse field electrophoresis; principle and applications of centrifugation, differential centrifugation, density gradient centrifugation and ultracentrifugation; cell separation by flow cytometry.

Unit-III

Paper chromatography (ascending and descending, 2-Dimensional); principle and applications of thin layer chromatography (TLC), column chromatography (gel filtration, ion exchange and affinity chromatography); methods of ligand immobilization, immuno-adsorption-hydrophobic interaction chromatography, metal chelate chromatography, covalent chromatography, high performance liquid chromatography (HPLC) and gas liquid chromatography (GLC).

Unit-IV

Principle and instrumentation of UV-visible, infrared spectroscopy, atomic absorption spectrophotometry, NMR spectroscopy, X-ray diffraction spectroscopy, N-terminal sequencing and peptide synthesis, introduction to proteomics, Yeast 2- hybrid and 3-hybrid systems, EMSA, foot printing, phage display, principle of mass spectrometry, electrospray ionization MS, MALDI, tandem MS for protein identification, ICAT-MS.

Suggested readings:

1. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Wilson K and Walker J, Cambridge University Press, ISBN No. 131661476X.
2. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder D, W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.

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SEMESTER – I

Course Title: Practical-I

Course Code: SIAL SC 1 1 06 C 00105

Credit: 5

Lecture: 150

1. Laboratory orientation, calibration, and demonstration of equipment.
2. Solutions, pH and buffers
3. Determination of pKa of acetic acid and glycine
4. Qualitative tests for carbohydrates, lipids, amino acids, and proteins in food samples
5. Metaphase chromosome preparation with G banding and C banding from blood sample
6. RNA *in-situ* hybridization to study gene expression in tissue section
7. Inheritance patterns in man – numerical on pedigree analysis- autosomal patterns, X-linked patterns, Y-linked patterns, mitochondrial inheritance patterns
8. Numerical on Hardy-Weinberg equilibrium
9. Numerical on linkage mapping
10. Different staining methods and microscopic examination of bacteria, actinomycetes, algae, fungi and protozoa
11. Preparation of specific media for isolation of bacteria, and fungi from natural sources
12. Cell counting and cell viability assay
13. Production of microbial enzymes (amylase, phosphatase) and their separation using chromatographic techniques
14. Biochemical characterization of microbial enzymes.
15. Separation of carbohydrates, amino acids and plant pigments using paper/thin layer chromatography
16. Detection of food adulterants
17. Evaluation of microbiological risks in food processing unit through microbiological risk assessment (MRA) tools
18. Assessment of nutritional status of different age group using anthropometric tools

Suggested readings:

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D, Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.
2. An Introduction to Practical Biochemistry (2017) 3rd ed., Plummer, D.T., McGraw Hill Education, ISBN: 978-0070994874.
3. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Wilson K, and Walker J, Cambridge University Press. ISBN: 131661476X.
4. Microbes in Action: A Laboratory Manual of Microbiology (1990) 4th Addition, Harry W, Seeley, Paul JV, John J, W. H. Freeman ISBN: 978-0716721000.
5. Genetics: A Laboratory Manual, (2009) 2nd ed., American Society of Agronomy; Lab Manual edition, ISBN: 978-0891185611.

6. Infant, Child and Adolescent Nutrition: A Practical Handbook (2013) 1st ed., More J, CRC Press, ISBN: 9781444111859.
7. Laboratory Manual of Microbiology and Biotechnology (2014) 1sted.Aneja KR, Scientific International Pvt., Ltd. ISBN: 9789381714553.
8. Microbiology: A Laboratory Manual (2017), 11th ed., Cappuccino, JH, Sherman, N., Pearson Education Inc, ISBN: 9780134298597.
9. An introduction to Practical Biochemistry (2017) 3rd ed., Plummer, DT, McGraw Hill Education, ISBN: 978-0070994874.

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SEMESTER-I

Course title - Principles of Biotechnology
Course Code - SIAL BT 1 1 01 GEC 4004

Credits: 4
Lecture: 60

Course objective: Provide basic understanding of biotechnology; it's scope and applications in the agriculture, medicine, industrial, environment and advancement of biology.

Learning outcomes:

- Opportunity for entrepreneurship in the area of bioeconomy and creation of wealth

Unit-I

An overview-definition, Scope and importance of biotechnology, Concepts of recombinant DNA technology and Gene Cloning. A brief account of microbes in industry and agriculture, Metabolic engineering for over production of metabolites.

Unit-II

Introduction to plant tissue culture and its applications, Gene transfer methods in plants, Transgenic plants (A brief introduction). *In-vitro* fertilization and embryo transfer in humans and livestock. Transfection techniques and transgenic and genome edited animals, Animal Cloning.

Unit-III

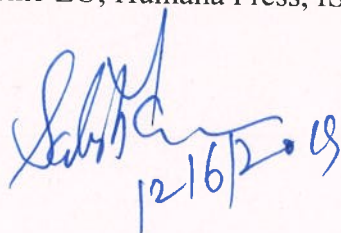
(A brief account) Biotechnology in medicine, Vaccines, Molecular diagnostics, Forensic, Gene therapy, Nano Medicine & Drug Delivery Cell & Tissue Engineering, Stem Cell therapy. (A brief account) Role of biotechnology in pollution control, Sewage treatment, Energy management, Bioremediation, Restoration of degraded lands and Conservation of biodiversity.

Unit-IV

An Overview, Insights and intervention into the Nano world, Important Developments, Societal implications & Ethical issues in Nanotechnology, applications of Nano-biotechnology in different areas. Biotechnology for developing countries and IPR

Suggested Readings:

1. Lehninger Principles of Biochemistry (2017) 7th ed., D.L. Nelson, M.M. Cox.. W.H. Freeman and Company, New York, USA, ISBN: 1-4641-2611-9.
2. Microbiology- Concepts and Applications, (1993) 6th ed., Pelczar MJ et. al., McGraw-Hill Inc, US, ISBN: 0070492581.
3. Plant Biotechnology – The genetic manipulation of plants (2017) 3rd ed., Slater A, Scott N and Fowler M, Oxford University Press, ISBN: 1138407674.
4. Animal Cell Culture Methods In: Methods in Cell Biology, (1998) Volume 57, 1st ed., Jenni P.M. and David B., Academic Press, eBook ISBN: 9780080859552.
5. Genome-4, (2017) Brown TA, Garland science, Taylor & Francis, NewYork, ISBN: 9780815345084.
6. Diagnostic and Therapeutic Antibodies (Methods in Molecular Medicine) George AJT, and Catherine EU, Humana Press, ISBN: 978-0-89603-798-4.


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SEMESTER-II

Course title: Immunology

Course code: SIAL SC 1 2 07 C 4004

Credit: 4

Lecture: 60

Course objective: To understand overall organization of the immune system and to identify the cellular and molecular basis of immune responsiveness.

Learning outcomes:

- Understanding the working mechanism of the immune system
- Understanding of antibody, MHC, complement system, cytokines, cancer, and organ transplant hypersensitivity

Unit-I

Host-defenses, hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT). Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, chemokines. Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

Unit-II

Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family. Multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification. Antigen independent phase of B cell maturation and selection, humoral response – T-dependent and T-independent response.

Unit-III

Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies. General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, pathways of antigen processing and presentation. Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation. General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

Unit-IV

Mechanism of tolerance, Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity. Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy, Immunohistochemistry, Immunocytochemistry and privileged sites. Vaccines - active and passive immunization, types of vaccines.

Suggested readings:

1. Kuby Immunology (2018) 8th ed., Punt J, Stranford S, Jones P and Owen JA, W.H Freeman and Company, ISBN: 978-1319114701.
2. Janeway's Immunobiology (2017) 9th ed., Murphy KM and Beaver C, WW Norton and Company, ISBN: 978-0815345510.
3. Roitt's Essential Immunology (2017) 13th ed., Delvis PJ, Martin SJ, Burton DR and Roitt, IM, Wiley-Blackwell, ISBN: 978-1118415771.

4. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
5. Lippincott's illustrated Reviews Immunology (2012) 2nd ed., Doan T, Melvold R, Viselli S and Waltenbaugh, C, Wolters Kluwer India Pvt, Ltd, ISBN: 978-8184737639.

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SEMESTER-II

Course title: Biosafety, Bioethics and IPR
Course code: SIAL SC 1 2 08 C 3003

Credit: 3
Lecture:45

Course objective: To introduce the concept of intellectual property rights, patenting and emphasis on biosafety and bioethics.

Learning outcomes:

- Understanding the basics of intellectual property rights
- Understand the importance and level of biosafety at laboratory and industrial levels
- Understand ethical practices and concepts appropriate to the discipline

Unit-I

Biosafety: introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs; principles of safety assessment of transgenic plants – sequential steps in risk assessment; concepts of familiarity and substantial equivalence; risk – environmental risk assessment and food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan; risk assessment of transgenic crops vs cisgenic plants or products derived from RNAi, genome editing tools. Regulations: International regulations-Cartagena protocol, OECD consensus documents and Codex Alimentarius; Indian regulations-EPA act and rules, guidance documents, regulatory framework-RCGM, GEAC, IBSC and other regulatory bodies.

Unit-II

Bioethics: Introduction, ethical conflicts in biological sciences-interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research - cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology-Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity - biopiracy.

Unit-III

Patenting: Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications, PCT and conventional patent applications.

Unit- IV

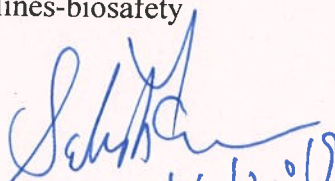
International patenting-requirement, procedures and costs; financial assistance for patenting, introduction to existing schemes; publication of patents-gazette of India, status in Europe and US; patent infringement- meaning, scope, litigation, case studies and examples

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commercialization of patented innovations; licensing-outright sale, licensing, royalty; patenting by research students and scientists-university/organizational rules in India and abroad, collaborative research-backward and forward IP; benefit/Credits sharing among parties/community, commercial (financial) and non-commercial incentives.

Suggested readings:

1. Office of the Controller General of Patents, Design & Trademarks; Department of Industrial Policy & Promotion; Ministry of Commerce & Industry; Government of India. <http://www.ipindia.nic.in/>
2. World Trade Organisation. <http://www.wto.org>
3. World Intellectual Property Organisation. <http://www.wipo.int>
4. International Union for the Protection of New Varieties of Plants. <http://www.upov.int>
5. National Portal of India. <http://www.archive.india.gov.in>
6. IPR, Biosafety and Bioethics (2013) Parashar S, Goel D, Pearson Publishing India, ISBN: 9788131774700.
7. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology (2017) Nambisan P, Academic Press, ISBN: 9780128092316.
8. <http://dbtindia.gov.in/guidelines-biosafety>


12/6/2019

SEMESTER-II

Course title: Genomics and Genetic Engineering

Course code: SIAL SC 1 2 09 C 4004

Credit: 4

Lecture: 60

Course objective: To provide basic and high throughput techniques in the areas of genomics and genetic engineering.

Learning outcomes:

- Understanding of high throughput techniques used in genomics and transcriptomics
- Understand concept of genetic engineering including the techniques, applications and limitations
- Demonstrate the ability of designing recombinant molecules and conducting experiments involving genetic manipulation

Unit-I

Origin of genomics: The first DNA genomes, Structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes, Microbial genomes (including yeast), Plant genomes (Arabidopsis and rice), Animal genomes (fruit fly, mouse, human), Genomes and human evolution, The concept of minimal genome. Genetic maps, Physical maps, EST and transcript maps, Functional maps and Functional genomics, Human genome project-landmarks on chromosomes generated by various mapping method, Comparative genomics and colinearity/syteny in maps, Genetic variation polymorphism, deleterious mutation; FISH to identify chromosome landmarks.

Unit-II

BAC libraries and shotgun libraries preparation (shotgun sequencing); Clone-by-clone or 'hierarchical shotgun' Sequencing, Next Generation sequencing, Genomics in medical practice, personalized medicine, use of SNP in pharmacogenomics, DNA Microarray technology: Basic principles and design, Global gene expression analysis, Comparative transcriptomics, Differential gene expression.

Unit-III

Recombinant DNA Technology: Enzymes used in Recombinant DNA technology (Restriction endonucleases, DNA modifying enzymes, other nucleases, Polymerases, Ligase, kinases and phosphatases), Isolation and purification of DNA (genomic and plasmid) and RNA. Various methods of separation, characterization of nucleic acids including Southern and Northern hybridizations, Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors and their purification.

Unit-IV

Western blotting, generation of genomic and cDNA libraries. plasmid, phage, cosmid, BAC and YAC vectors. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms. Isolation and amplification of specific nucleic acid sequences, PCR, RT-PCR and qRT-PCR, DNA sequencing methods, strategies for genome sequencing. Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques. Site-directed Mutagenesis, protein engineering. Applications of genetic engineering in plants and animal improvements.

Suggested readings:

1. Principles of Gene Manipulation and Genomics (2016) 8th ed., Primrose, SB and Twyman, R, Wiley Blackwell, ISBN: 978-1405156660.
2. Gene Cloning and DNA Analysis: An Introduction (201978-6) 7th ed., Brown, TA, Wiley Blackwell, ISBN: 978-1119072560.
3. Genome 4 (2017) 4th Brown, TA, Garland science, ISBN 13: 978-0815345084.
4. Introduction to Genomics (2015) 2nd ed., Lesk, AM, Oxford university Press India, ISBN: 978-0198745891.
5. Genomics and Personalized Medicine: What Everyone needs to Know (2016) 1st ed., Snyder, M, OUP-USA, ISBN: 978-0190234768.

Sahib
12/6/2019

SEMESTER-II

Course title: Bioprocess Engineering and Technology
Course code: SIAL BT 1 2 01 C 4004

Credit: 4
Lecture: 60

Course objective: To provide fundamental concepts of bioprocess technology and to overcome the challenges of the new and emerging areas of biotechnology industry.

Learning outcomes:

- Understanding of design and operations of a process for bio-based products
- Understanding the structure, operation and functions of various fermenters
- Critical analysis and improvement in any bioprocess from market point of view

Unit-I

Microbial growth and death kinetics; Ideal and non-ideal reactors; Residence Time Distribution; Unstructured models of microbial growth; structured models of microbial growth. Elements in bioreactor design- overview of bioreactor, Construction materials, types of bioreactors, its developments using microbial processes, mammalian cell culture, and plant cell culture, components of bioreactors and importance.

Unit-II

Analysis of batch and continuous culture; modifying batch and continuous reactors; fed-batch operations; Multiphase bioreactor system; upstream processing: media formulation and optimization; sterilization (medium and air)-thermal death kinetics of microorganisms; aeration, agitation and heat transfer in bioprocess; Translation of laboratory, pilot and plant scale data-scale up and scale down.

Unit-III

Separation of insoluble products-filtration, centrifugation, sedimentation, flocculation; Cell disruption; separation of soluble products: liquid-liquid extraction, precipitation, chromatographic techniques, reverse osmosis, ultra and micro filtration; final purification: drying; crystallization; storage and packaging.

Unit-IV

Monitoring of Bioprocesses: On line data analysis for measurement and control of important physicochemical and biochemical parameters, parameter estimation techniques for biochemical processes, parameter estimation techniques for biochemical processes, Computer based data acquisition. Techno-economic feasibility of bioprocess; effluent treatment and disposal.

Suggested Readings:

1. Bioprocess Engineering: Basic Concepts (2017) 3rd ed. Shuler, ML, and Kargi, F. Pearson Prentice Hall, ISBN: 0137062702.
2. Principles of Fermentation Technology (2016) 3rd ed. Stanbury P, Allan Whitaker, Stephen Hall. Imprint (Butterworth-Heinemann), ISBN: 9780080999531.
3. Biochemical Engineering Fundamentals (2013) 5th reprint J. E. Bailey and Ollis, D. F. McGraw-Hill Education (India) Pvt Ltd., ISBN: 0070701237.
4. Bioprocess Engineering Principles (2013) 2nd ed. Doran, P.M, Academic Press, ISBN: 978-0-12-220851-5.
5. Bioreactors Analysis and Design (2011) Panda T, Tata McGraw Hill, ISBN: 978007-070424-4.

SEMESTER-II

Course title: Cell and Tissue Engineering
Course code: SIAL BC 1 2 01 DCEC 4004

Credit: 4
Lectures: 60

Course objective: To design, optimize and maintain biomedical systems in tune with community needs and environmental concerns.

Learning outcomes:

- Designing a system to meet desired needs within realistic constraints
- Understanding professional and ethical responsibilities as well as regulatory issues

Unit-I

Definition of biomaterials, requirements of biomaterials, classification of biomaterials, properties of common biomaterials, Physical and mechanical properties of biomaterials, Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk, hydrogels and polylactic acid), 3-D architecture/printing and cell incorporation, Biocompatibility, basic transplant immunology.

Unit-II

Fundamental of tissue engineering, Structural and organization of tissues: Epithelial, Endothelial, Mesenchymel, Connective. Basic wound healing, cell migration, in-vitro testing.

Unit-III

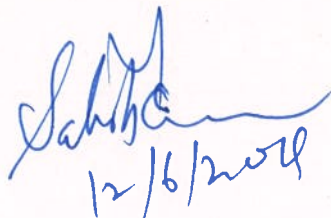
Types of cells for tissue engineering, progenitor cells and cell differentiations, cell matrix and cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, genetic engineering of cell, cell storage and cell characterization, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and tissue specific cell surface markers.

Unit-IV

Tissue engineering of Bone, Cartilage, Blood vessels, Heart, Cell transplantation, Ethical, social and regulatory issues with tissue engineering.

Suggested readings:

1. Principles of Tissue Engineering (2013) 4th ed., Lanza, RP, Langer, R and Vacanti, JP, Academic Press, ISBN 13: 978-0123983589.
2. Biomaterials (Bioengineering and Health Science (2014) 1st ed., Migonney, V, ISTE Ltd., ISBN-13: 978-1848215856.
3. Nanomedicine and Tissue Engineering: State of the Art and Recent Trends (2016) 1st ed., Kalarikkal, N, Augustine, R, Oluwafemi, OS, Joshy, KS and Thomas, S, Apple Academic Press. ISBN 13: 978-1771881180.
4. Tissue Engineering (2018) 2nd ed., Blitterswijk, CV and Boer, JD, Academic Press ISBN 13: 978-0128100288.
5. Biomaterials: A Basic Introduction (2018) 1st ed., Chen, Q and Thouas, G, CRC Press, ISBN 13: 978-1138749665.


12/6/2018

SEMESTER-II

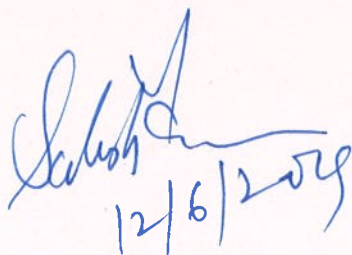
Course title: Practical-II

Course code: SIAL BT 1 2 03 C 00105

Credit: 5

Lectures: 150

1. Determination of A, B, O and Rh blood groups in human beings
2. Detection of antigen/antibody in a given sample using Enzyme Linked Immunosorbent Assay (ELISA)
3. Polyclonal antibody production in mice/rabbit and detection using antigen
4. DNA extraction and amplification of desired gene using PCR technique
5. Restriction analysis and DNA finger printing methods, RAPD, SSR etc.
6. RNA extraction and cDNA synthesis using reverse transcription process
7. Hydroponic culturing of plantlets under normal and stressed conditions.
8. Callus culture using various explants, regeneration of shoots and root induction.
9. Protoplast isolation, culture and visualization using Calcofluor staining.
10. Preparation of artificial seeds through gel entrapment and viability testing
11. To determine Volumetric Oxygen Transfer Coefficient (kLa) in fermentation system by dynamic method/sulphite method.
12. Comparative studies on the kinetics of free and immobilized enzymes/cells.
13. To estimate growth kinetic parameters of *Escherichia coli* in a bioreactor and analysis of various parameters.
14. Data Analysis Introduction to Metabolic Flux Analysis (MFA).
15. Comparative study of batch, fed-batch and continuous fermentations in a fermenter
16. To study various techniques for the separation of soluble and insoluble components of a biological mixture
17. To study dye decolorization using microbial/plant biomass or metabolites
18. Analysis of emerging pollutants in municipal/domestic wastewater


12/6/2019

SEMESTER-II

Course title: Research Methodology and Scientific Communication Skills
Course code: SIAL SC 1 2 10 DCEC 2002

Credit: 2
Lectures: 30

Course objective: To provide knowledge about tools and techniques related with scientific communication and research methodology.

Learning outcomes:

- Understanding the existence of scientific knowledge in ancient times
- Acquiring the skills of scientific reading, writing and presentations
- Appreciating the scientific ethics through case studies

Unit-I

Empirical science; scientific method; manipulative experiments and controls; deductive and inductive reasoning; descriptive science; reductionist vs holistic biology.

Unit-II

Choosing a mentor, lab and research question; maintaining a lab notebook. Concept of effective communication- setting clear goals for communication; determining outcomes and results; initiating communication; avoiding breakdowns while communicating; creating value in conversation; barriers to effective communication; non-verbal communication-interpreting non-verbal cues; importance of body language, power of effective listening; recognizing cultural differences.

Unit-III

Presentation skills - formal presentation skills; preparing and presenting using over-head projector, PowerPoint; defending interrogation; scientific poster preparation & presentation; participating in group discussions; Computing skills for scientific research - web browsing for information search; search engines and their mechanism of searching; hidden Web and its importance in scientific research; internet as a medium of interaction between scientists; effective email strategy using the right tone and conciseness.

Unit-IV

Technical writing skills - types of reports; layout of a formal report; scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts; publishing scientific papers - peer review process and problems, recent developments such as open access and non-blind review; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.

Suggested readings:

1. Research Methodology: Methods And Techniques (2019) 4th ed., Kothari CR and Garg G, New Age International Publishers, ISBN: 978-9386649225.
2. Communicate Science Papers, Presentations, and Posters Effectively (2015) Patience GS, Boffito DC, Patience P, Academic Press, ISBN: 978-0128015001.

Salish Chandra
12/6/2019

3. **Successful Scientific Writing: A Step-by-Step Guide for the Biological and Medical Sciences** (2014) 4th ed., Matthews JR and Matthews RW, Cambridge University Press ISBN: 978-1107691933.
4. **Doing Science: Design, Analysis, and Communication of Scientific Research.** (2001) Valiela I, Oxford: Oxford University Press, ISBN 10:019538573X.
5. **On Being a Scientist: a Guide to Responsible Conduct in Research.** (2009) 3rd ed., Washington DC, National Academies Press.

Schiffman
12/6/2019

SEMESTER-II

Course title: Bio-entrepreneurship
Course code: SIAL SC 1 2 11 DCEC 2002

Credit: 2
Lectures: 30

Course objectives: To teach students about concepts of entrepreneurship including identifying a winning business opportunity, gathering funding and launching a business, growing and nurturing the organization and harvesting the rewards.

Learning Outcomes:

- Gain entrepreneurial skills and understand the various operations involved in venture creation
- Identifying scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centres and various agencies

Unit-I

Introduction and scope in Bio-entrepreneurship, Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech), Strategy and operations of bio-sector firms: Factors shaping opportunities. For innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities, Alternatives faced by emerging bio-firms and the relevant tools for strategic decision, Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies.

Unit-II

Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills.

Unit-III

Business plan preparation including statutory and legal requirements, Business feasibility study, financial management issues of procurement of capital and management of costs, Collaborations & partnership, Information technology.

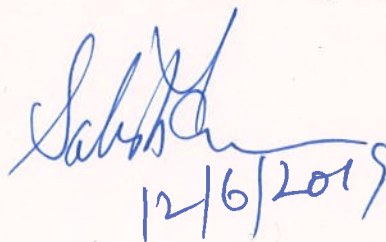
Unit-IV

Technology – assessment, development & upgradation, Managing technology transfer, Quality control & transfer of foreign technologies, Knowledge centers and Technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GCP, GLA, GMP).

Suggested readings:

1. Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge, Routledge Studies in Innovation, Organizations and Technology (2018) 1st ed. Onetti, A, & Zucchella, A, CRC press, Taylor and Francis group. ISBN: 9781138616905.
2. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Shimasaki, CD (2014) Amsterdam: Elsevier. Academic Press is an imprint of Elsevier, ISBN: 0124047300.

3. Innovation, Commercialization, and Start-Ups in Life Sciences. (2014) 1st ed. Jordan, JF, CRC Press. Taylor and Francis group, ISBN: 9781482210125.
4. The Dynamics of Entrepreneurial Development and Management. (2011) 6th ed., Desai V, New Delhi: Himalaya Pub. House, ISBN: 9350244543.
5. Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences (2008) Adams, DJ, Sparrow JC, Bloxham, Scion, ISBN:1904842364.


12/6/2019

SEMESTER-II

Course title: Pharmaceutical Biotechnology

Course code: SIAL BT 1 2 01 DCEC 4004

Credit: 4

Lectures: 60

Course objective: To provide basic and applied knowledge of biotechnological processes in the field of drugs and vaccines.

Learning outcomes:

- Understanding the roles of biomolecules in the treatment of diseases
- Knowledge of developing new drug and vaccine products
- Understanding role of genomic information in development and treatment of diseases

Unit-I

Biotechnology in pharmaceutical perspective: Biology in drug discovery; Traditional drug discovery vs. rational drug discovery, rational drug discovery pipeline, concept of target based drug design and target discovery, role of plant biotechnology in edible vaccine development. Definition: Generics and its advantages; Biogenerics and Biosimilars; Why biosimilars are not (bio) generics; The advent of Biosimilars; Protein-based biopharmaceuticals; Manufacturing processes; Global market; International Non-proprietary Names (INN) nomenclature system biosimilars regulation (EU position, US pathways, Government initiatives).

Unit-II

Biotechnology in pharmaceutical industry: Major areas for biotechnology in the pharmaceutical industry such as antibiotics, vaccines, diagnostics, antibodies, biopharmaceuticals (insulin, interferon, GSF, CSF & therapeutic proteins etc.); Commercial aspects, priorities for future biotechnological research.

Unit-III

Industrial enzymes in drug development: Penicillin amidase, lipase, oxidoreductase, nitrilase, protease etc. Use of all these enzymes for enantioselective synthesis of pharmaceutically important drugs / drug intermediates, future directions.

Approved follow-on proteins/Biosimilars; Characteristics of high-selling peptides and proteins; Products with expired patents; Challenging originator's patents; Target products for FOB (follow-on biologicals)/ Biosimilars development peptides; Recombinant nonglycosylated proteins; Recombinant glycosylated proteins; Industries dealing with biogenerics and its market value; World scenario; Indian scenario.

Unit-IV

Genomics in target discovery: Concept of genome, genes and gene expression, genome sequencing and sequence comparison methods (e.g. BLAST), gene expression comparison methods (microarray). Comparative genomics and expression genomics for target discovery of communicable diseases and lifestyle disease.

Suggested readings:

1. Pharmaceutical Biotechnology (2016) Helmer E, Syrawood Publishing House, ISBN: 978-1682861066.
2. Pharmaceutical Biotechnology (2014) Sreenivasulu V, Jayaveera KN and Adinarayana K, S Chand & Company, ISBN: 978-8121942478.

3. Pharmaceutical Biotechnology Fundamentals and Application (2013) Kokare C, Nirali Prakashan, Educational Publishers, ISBN: 978-8185790688.
4. Pharmaceutical Biotechnology: Concepts and Applications (2011) Walsh G, Wiley India Pvt Ltd, ISBN: 978-8126530250.
5. Pharmaceutical Biotechnology (2002) 2nd ed. Cromelin DJA and Sindelar RD, Taylor and Francis Group, ISBN: 978-3-527-65125-2.

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SEMESTER-II

Course title: Microbial Biotechnology

Course code: SIAL BT 1 2 02 DCEC 4004

Credit: 4

Lectures: 60

Course objective: To introduce students to basic and advanced knowledge in the field of microbial technology and fermentation for use in human welfare.

Learning outcomes:

- Understanding microbial fermentation for the production of useful products
- Understanding basic techniques related to downstream processing of alcohols, enzymes and organic acids
- Understanding the fermentation process of genetic engineered microorganisms

Unit-I

Fermentative production of industrial alcohol, uses, raw materials, microorganisms, inoculums preparation, preparation of wort, fermentation and recovery. Fermentative production of beer – Medium components, malt, malt adjuncts, hops, water. Preparation of wort, mashing, wort boiling, microorganism, inoculum preparation, fermentation, cold storage maturation, carbonation, packing and preservation. Principles of wine making – Fruit selection, picking, crushing, sulphite addition, processing, fermentation, aging and bottling.

Unit-II

Fermentative production of citric acid, uses, microorganism, inoculum preparation, medium preparation, fermentation, recovery and mechanism of citric acid production. Fermentative production of vitamin B12 – Uses, structure of vit-B12, microorganisms, inoculums preparation, medium preparation, fermentation and recovery. Fermentative production of glutamic acid – Uses, microorganism, inoculum preparation, production medium, fermentation and downstream processing

Unit-III

Antibiotics – Commercial production of benzyl penicillin, uses, microorganism, inoculums preparation, production medium, fermentation, recovery and semi-synthetic penicillins. Fermentative production of tetracyclines-uses, chlortetracycline, oxy-tetracycline, tetracycline and semisynthetic tetracyclines, structures, microorganisms, inoculum preparation, production medium, fermentation and recovery methods.

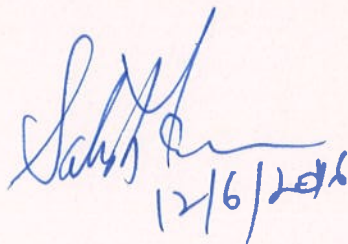
Unit-IV

Production and application of microbial enzymes. – Amylases and proteases, uses, microorganisms, inoculum preparation, production medium, fermentation and recovery, steroid transformations-substrates, typical structures, microorganisms, inoculum preparation, 11-hydroxylation, process and recovery. Principles of vaccine production and types of vaccines, Microbial biopesticides, microbial products from genetically modified organisms eg. insulin.

Suggested readings:

1. Microbial Biotechnology: Progress and Trends (2017) 1st ed., Harzevili FD and Chen H, CRC Press; ISBN: 978-1138748699.
2. Microbial Biotechnology (2016) Cooper E, Syrawood Publishing House, ISBN: 978-1682860977.

3. Encyclopedia of Metagenomics. Genes, Genomes and Metagenomes: Basics, Methods, Databases and Tools (2015). Nelson, KE Boston, MA, Springer US, ISBN: 978-1-4899-7479-2.
4. Microbial Biotechnology: Principles and Applications. Hackensack, (2013). 2nd ed. Lee, YK, World-Scientific. ISBN: 978-981-256-676-8.
5. Comprehensive Biotechnology (2011) 3rd ed., Moo-Young, M, Elsevier, ISBN: 9780444640468.


12/6/2016

SEMESTER-II

Course title: Environmental Biotechnology
Course code: SIAL BT 1 2 02 DCEC 4004

Credit: 4
Lecture: 60

Course objective: To provide information about various factors responsible for environmental pollution and its mitigation using biotechnology.

Learning outcomes:

- Understanding the source and mechanism of environmental pollution
- Understanding the role of microbes and plants in remediation and management of environmental pollution
- Understanding the replacement/options available for non-degradable pollutants

Unit-I

Water, Soil and Air: their sources and effects. Major pollutants and their effects on flora and fauna, Removal of Specific Pollutants, concepts of bioaugmentation, biostimulation, biodegradation, biosorption and biofilms in the bioremediation of pollutants, Sources of Heavy metal pollution, microbial systems for heavy metal accumulation, biosorption & detoxification mechanisms. In-situ and ex-situ bioremediation strategies.

Unit-II

Primary, secondary and tertiary treatment of waste water, biological treatment of anaerobic and aerobic; biochemistry and microbiology of aerobic and anaerobic treatment, use of genetically engineered organisms. Emerging biotechnological processes in waste - water treatment, Bioremediation of contaminated ground water; Membrane technology in waste water treatment, Bioreactors for waste water treatment, treatment of typical industrial effluents: dairy, distillery, dye, and pharmaceutical industries.

Unit-III

Solid waste treatment, characteristics of municipal, industrial and biomedical wastes; Aerobic and anaerobic methods, Physical and chemical treatment of solid waste, Composting and vermin-composting. Use of bacteria, fungi, plants, enzymes, and GE organisms; Bioremediation of contaminated soils and waste land. Phytoremediation of soil metals; Treatment for waste water from dairy, distillery, tannery, sugar and antibiotic industries.

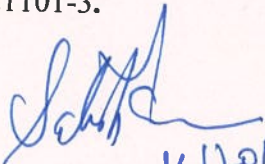
Unit-IV

Xenobiotic compounds: aliphatic, aromatics, polyaromatic hydrocarbons, polycyclic aromatic compounds, pesticides, surfactants and microbial treatment of oil pollution. Basic organic reaction mechanism - common prejudices against enzymes - advantages & disadvantages of biocatalysts - isolated enzymes versus whole cell systems.- mechanistic aspects and enzyme sources.- biocatalytic application, kinetics, and thermodynamics of microbial processes for the transformation of environmental contaminants. Use of solar radiation in industrial effluent treatment; solar detoxification process; environment friendly technologies: biosurfactants, biofertilizers, biopesticides, microbial enhanced oil recovery, resource management, integrated waste management; production of biogas and biofuel from waste.

Suggested readings:

1. Environmental Science and Technology, (2019) 9th ed., Stankey EM, Lewis Publishers, New York. ISBN: 1420059203.

2. Environmental Biotechnology: Principles and Applications (2017) 1st ed., Rittmann B and Mccarty P, McGraw Hill Education; ISBN: 978-1259002885.
3. Environmental Biotechnology: Biodegradation, Bioremediation, and Bioconversion of Xenobiotics for Sustainable Development (2016) 1st ed., Sangeetha J, Thangadurai D, David M and Abdullah MA, Apple Academic Press; ISBN: 978-1771883627.
4. Environmental Biotechnology: Basic Concepts and Applications (2011) 2nd ed., Thakur IS, I K International Publishing House Pvt. Ltd; ISBN: 978-9380578477.
5. Biodegradation and Bioremediation: (2004), Singh A. and Ward O.P., Soil Biology, Springer, ISBN: 978-3-540-21101-3.


12/6/2019

SEMESTER-III

Course title: Biostatistics and Bioinformatics

Course code: SIAL SC 1 3 12 C 4004

Credit: 4

Lectures: 60

Course objective: To introduce the students in the field of bioinformatics and enables them to understand the concepts of statistics in biology.

Learning outcomes:

- Understanding statistical analysis of biological data
- Understanding the role of computer science in predicting structure and function of biomolecules
- Understanding similarities and differences among living organisms on the basis of genetic information

Unit-I

Definition of selected terms scale of measurements related to statistics; Methods of collecting data, Presentation of data statistical Tables, Need for reduction of data measures of averages and location, Measures of dispersion: Range, quartile deviation, mean deviation and relative deviation. Probability: basic concepts; basic theorems of probability addition and multiplication theorems; conditional probability of Bayes Theorems. Probability mass function, probability density function, cumulative distribution function.

Unit-II

Probability distribution definition and applications; Binominal distribution, Poisson distribution, Normal distribution, logic of statistical standard error estimation testing of hypothesis. Tests of significance: Null hypothesis, alternative hypothesis, type I error, type II error, level of significance, and power of test. Tests for mean based on normal distribution, one sample t-test, two-sample t-test, paired-sample t-test, Chi-Squared test, and Tests for variance based on normal distribution – one sample and two-sample problem. One-way and Two-way analysis of variance (ANOVA) techniques. Correlation concept and applications, Spearman's rank correlation coefficient, regression concept and applications.

Unit-III

Historical background. Scope of bioinformatics - genomics, proteomics, computer aided drug design (structure based and ligand based approaches), Applications of bioinformatics. Introduction to biological databases - primary, secondary and composite databases, Different formats of molecular biology data. NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB)

Unit-IV

Similarity, identity and homology. Alignment-local and global alignment, pairwise and multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTAL omega. Identification of open reading frames (ORF), Concept of orthology, paralogy and homology in gene and protein sequences. Methods and tools for phylogenetic analysis, maximum parsimony, maximum likelihood and distance methods; creation, evaluation and interpretation of evolutionary trees phylogenetic tree.

Suggested Readings:

1. Fundamentals of Statistics (2016) Goon, AM, Gupta, MK and Dasgupta, B. Vol. I & II. World Press, ASIN: B01LB7MH74.

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2. Statistical Methods (2012) 1st ed., Das, NG. Vol I & II. Tata McGraw Hill, ISBN: 9780070263512.
3. Probability and Statistics for Engineers and Scientists (2013) 9th ed., Walpole, RE, Myers, RH, Myers, SL and Ye, Pearson Education India KE ISBN: 978-9332519084
4. Biostatistics: A Foundation. for Analysis in the Health Sciences (2012) 10th ed., Daniel, WW and Cross, CL. John Wiley & Sons, ISBN: 978-1118302798
5. Essential Bioinformatics (2006) 1st ed., Xiong J, Cambridge University Press, ISBN 13: 978-0521600828.
6. Fundamental concepts of Bioinformatics (2003) Krane DE and Raymer ML Pearson, ISBN: 978-8177587579.
7. An Introduction to Bioinformatics (2017) 1st ed., Knight R, Larsen and Keller Education, ISBN: 978-1635490459.
8. Concepts of Bioinformatics and Genomics (2016) 1st ed., Momand J, McCardy A, Heubah, S and Warter-Perez N, Oxford University Press, ISBN: 978-0199936991

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12/6/2019

SEMESTER-III

Course title: Biophysics and Nanosciences

Course code: SIAL SC 1 3 13 C 4004

Credit: 4

Lectures: 60

Course objectives: To explore the complexity of living systems with a quantitative physical approach, fundamentals of nanoscale structured materials and also discuss various biomedical & agricultural applications of different nanomaterials.

Learning outcomes:

- Understanding the core concepts of biology, chemistry and physics and how they interconnect in biophysical systems
- Expansion of knowledge of standard molecular and biophysical techniques to design experiments in a specific research area
- Understanding fundamental principles of nanotechnology also discuss state-of-the-art synthesis of different nanomaterials
- Elucidating the emerging need of nanotechnology in environment, health; and safety, and incorporate them into basic education that can be immediately employed in industry

Unit-I

Introduction to Biophysics and history of Biophysics, main features of quantum theory, Elementary particles and their interactions, mechanism of molecular energy transfer, Distribution of molecular energy and velocity at equilibrium, Energy of activation, Different types of forces and stereo-chemical factors responsible for molecular conformation, Defining conformation of a macromolecular chain, complex array of biomolecular structures found in DNA and proteins due to interactions. Main methods of studying the structure of proteins and DNA, protein folding pathways, Levinthal's paradox, Molten globule, Anfinsen's experiment, Methods for investigating folding: Fluorescence spectroscopy, Circular dichroism. Macromolecular interactions, Biophysical methods of interactions: Microcalorimetry (Isothermal Titration Calorimetry (ITC), Surface Plasmon Resonance (SPR).

Unit-II

Basic concepts and laws of thermodynamics, Gibbs free energy, Enthalpy and Entropy, Energetic processes in living organism, Information and Entropy, Coupling of fluxes, Coupling of Chemical Reactions, Redox potential in biological system, ATP production. Introduction to membrane Biophysics, fundamental role of biomembranes, interfacial phenomena and membranes, surface and interfacial tensions, self-assembly of membranes, molecular structure of membranes, Structure & function of membranes, Nernst equation (based on membrane permeable for a single kind of ions), Resting membrane potential, Action potential, Biophysics of synapse, patch clamping/voltage clamp and their applications to the study of biomacromolecules.

Unit-III

Overview of Nanotechnology - Historical perspective of integration of biology, chemistry, and material science. Opportunities and promises of Nanobiotechnology. Top down and bottom up approaches of synthesis of nanoparticles, synthesis of nanoparticles by physical, chemical and biological methods; nucleation and growth of nanosystems, factors affecting synthesis of nanoparticles, Debye-Scherrer method, particle size determination using UV absorption spectra peaks and photoluminescence peaks, dynamic light scattering (DLS), SEM. Nanomaterials used in biotechnology-nanoparticles, carbon nanotubes, quantum dots and nanofibres.

Unit-IV

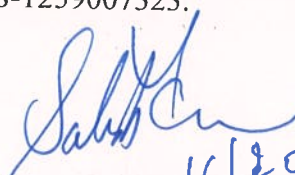
Miniaturized Devices-nanotechnology and biomedical devices: Overview of smart devices for medical field, lab on chip concept, epipen, intelligent pill, wobbling gels.

Nanotechnology and diagnostics and therapy-Nano-Biosensing-biosensors and nanobiosensors -basics, DNA aptamers for nano-biosensing. Use of nanotechnology in diagnosis of chronic diseases like diabetes and coronary heart diseases; parasitic disease like malaria.

Nanotechnology in agriculture, food technology & environment: Insecticides development using nanotechnology and Nanofertilizers, nanotechnology in food processing, safety & smart packaging, applications of nanotechnology in water purification and oil spill removal.

Suggested readings:

1. An introduction to Biophysics (2018), 1st ed., Burns, D, Forgotten Books, ISBN: 978-1330860212.
2. Biophysics - An Introduction (2014) 1st ed., Cotterill, R, Wiley, ISBN: 978-8126551606.
3. Biophysics: An Introduction (2012) 2nd ed., Glazer, Springer, ISBN: 978-3642252112.
4. Nanobiotechnology: Concepts, Applications and Perspectives (2012) 1st ed., Niemeyer, CM and Mirkin, CA, Wiley India Pvt Ltd., ISBN 13: 978-8126538409.
5. A Textbook of Nanoscience and Nanotechnology (2017) 1st ed., Pradeep T, McGraw Hill Education, ISBN: 978-1259007323.


12/6/2019

SEMESTER-III

Course title: Metabolic Engineering
Course code: SIAL BT 1 3 04 C 4004

Credit: 4
Lectures: 60

Course objective: To cover basic as well as applied aspects of metabolic engineering.

Learning outcomes:

- Understanding of applicability of metabolic engineering in changing the flux
- Understanding the engineering of metabolic pathway for directed product/metabolite synthesis

Unit-I

Historical perspective and introduction; Importance of metabolic engineering; Paradigm shift; Information resources; Scope and future of metabolic engineering; Building blocks of cellular components; Polymeric biomolecules; Protein structure and function; Biological information storage – DNA and RNA.

Unit-II

Transport mechanisms and their models; Enzyme kinetics; Mechanisms and their dynamic representation; Regulation of enzyme activity versus regulation of enzyme concentration; Regulation of metabolic networks; Regulation of at the whole cell level; Examples of important pathways; Case studies and analytical-type problems.

Unit-III

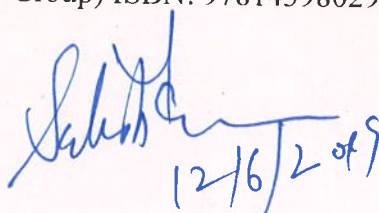
The theory of flux balances; Derivation of the fundamental principle; Degree of freedom and solution methods; Moore-Penrose inverse and Tsai-lee matrix construction; Examples of applications of flux analysis introduction Metabolic Control Theory; Control coefficients; Elasticity coefficients; Summation and connectivity theorems; Case Studies and examples.

Unit-IV

The concept of metabolic pathway synthesis; Need for pathway synthesis, Examples for illustration; Overall perspective of MFA, MCA and MPA and their applications; Three success case studies.

Suggested readings:

1. Metabolic Engineering (2016) Becker R, Syrawood Publishing House, ISBN: 978-1682861530.
2. Systems Metabolic Engineering (2014) Wittmann C, and Lee SY, Springer, ISBN: 978-940178319.
3. Metabolic Engineering for Bioprocess Commercialization (2016) 1st ed., Stephen VD, Springer, ISBN-13: 978-3319419640.
4. Systems Metabolic Engineering (2012) C. Wittmann, Sang Yup Lee (Editors), Springer, ISBN: 9400745338.
5. The Metabolic Pathway Engineering Handbook (2009) Christina D. Smolke (Ed.), CRC Press (Taylor & Francis Group) ISBN: 9781439802960.


12/6/2019

SEMESTER-III

Course title: Medical Biotechnology and Diagnostics
Course code: SIAL BT 1 3 05 C 4004

Credit: 4
Lectures: 60

Course objective: To give an overview about the disease and its diagnostic techniques used in the medical field.

Learning outcomes:

- Understanding the basics of genetical information responsible for disease development
- Understanding the classical and advanced methods used for the diagnosis of various diseases
- Understanding the treatment of diseases using gene therapy and related therapies

Unit-I

Chromosomal disorders- Numerical disorders e.g. trisomies & monosomies, structural disorders e.g. deletions, duplications, translocations & inversions, Chromosomal instability syndromes. Gene controlled diseases – autosomal and X- linked disorders, mitochondrial disorders.

Pathogenic mutations. Gain of function mutations: oncogenes, Huntingtons disease, Pittsburg variant of alpha 1 antitrypsin. Loss of function -tumour suppressor, genomic, dynamic mutations - Fragile- X syndrome, myotonic dystrophy, mitochondrial diseases.

Unit- II

Invasive techniques - amniocentesis, fetoscopy, chorionic villi sampling (cvs), noninvasive techniques- ultrasonography, X-ray, TIFA, maternal serum and fetal cells in maternal blood, diagnosis using protein and enzyme markers, monoclonal antibodies, DNA/RNA based diagnosis Hepatitis, CML – bcr/abl, HIV - CD 4 receptor, microarray technology- genomic and cDNA arrays, application to diseases.

Unit-III

Overview of molecular diagnostics, molecular diagnostics: past, present, and future, History & scope, definition, principle of biosensors: classification of biosensors based on transducer & recognition element. Components & basic designing of Biosensors, different types of biosensors, nanotechnology and biosensors: carbon nanotubes, Gold nanoparticles. Latex agglutination test, enzyme linked immunosorbant assay, dot and slot blot assay.

Unit-IV

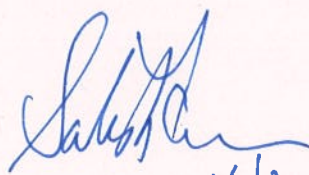
PCR in molecular diagnostics; multiplex-PCR, quantitative real time PCR (qRT-PCR) and their applications for diagnosis of disease applications, DNA diagnostic system: molecular beacons and its variants for their applications in detection, molecular diagnostics in bacterial detection, rolling circle amplification, application of padlock and selector probes in molecular medicine, DNA aptamers for nano-biosensing, diagnostics for point-of-care and resource limited settings, smartphones in medical diagnostics, rapid diagnostic tests (lateral flow assays), concepts of microfluidics, BioMEMs in diagnostics.

Suggested readings:

1. Human Molecular Genetics (2018) Strachan T and Read A, Garland Science publisher, ISBN: 9780815345893.
2. Medical Biotechnology (2013) Glick BR, Patton CL and Delovitch TL, ASM Press, ISBN: 155581705X.
3. Biotechnology in Medical Sciences (2017) Khan FA, CRC Press; ISBN: 978-1138076792

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4. Biomedical Nanotechnology (2005) 1st ed., Malsch, N, CRC Press, ISBN: 978-0824725792.
5. Biosensors and Nanotechnology: Applications in Health Care Diagnostics (2018) 1st ed., Altintas Z, Wiley-Blackwell, ISBN: 978-1119065012.
6. Biosensors: Essentials (2016) 1st ed., Evtugyn, G, Springer, ISBN: 978-3662509388
7. Nucleic Acids as Molecular Diagnostics (2014) 1st ed., Keller, A, Wiley VCH, ISBN: 978-3527335565.
8. Lateral Flow Immunoassay (2009) Raphael C. Wong, Harley YT, Humana Press, ISBN: 978-1-58829-908-6.
9. Medical Biotechnology (2013) Glick BR, Patton CL and Delovitch TL, ASM Press. ISBN10 155581705X.
10. Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine) (2004) Decker J, Reischl U, Humana Press, ISBN: 978-1-59259-679-9.
11. Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, (2006) Kayser O and Warzecha H, Wiley-Blackwell, ISBN: 978-3-527-60552.
12. Human Molecular Genetics (2018) Strachan T and Read A, Garland Science publisher, ISBN: 9780815345893.


12/6/2019

SEMESTER – III

Course title: Practical-III

Course code: SIAL BT 1 3 06 C 0084

Credit: 4

Lectures: 120

1. To study the laboratory organization and aseptic manipulations in plant and animal cell culture lab.
2. Isolation and culturing of animal cells from primary tissue explant.
3. Sub-culturing of monolayer confluent cells.
4. Counting of animal cells using haemocytometer.
5. Staining of monolayer confluent cells using geimsa and crystal violet.
6. To discriminate between viable and non-viable animal cells using trypan blue.
7. Database search (GenBank, PDB) using BLAST and Sequence submission protocols.
8. Sequence alignments (Pair wise and Multiple), Sequence and structure prediction
9. Construction of phylogenetic tree and prediction
10. Protein structure modelling and docking
11. Genomic DNA isolation from plant/bacteria and qualitative and quantitative analysis of DNA.
12. Bacterial culture: establishing a pure culture; identification of bacteria; staining techniques; antibiotic sensitivity of bacteria
13. Isolation of plasmid DNA, and its digestion by restriction endonucleases and separation of restriction fragments by agarose gel electrophoresis
14. Isolation of RNA and separation on agarose gel and Quantitative estimation of RNA
15. Green fluorescence protein (GFP) and bacterial transformation experiments
16. Western blot analysis of the proteins using antibodies
17. Denaturation kinetics study of biomolecules using UV-VIS spectrophotometry
18. Comparative study for the synthesis, characterization and applications of nanoparticles

Suggested readings:

1. An Introduction to Practical Biochemistry (2017) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN: 978-0070994874.
2. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Keith Wilson & John Walker, Cambridge University Press. ISBN: 131661476X.
3. Molecular cloning, A Laboratory Manual Vol. I-III. (2012) 4th ed., Green MR and Sambrook J, Cold Spring Harbor Laboratory Press.
4. Gene Cloning and DNA Analysis (2010) Brown TA, Wiley-Blackwell publishing .
5. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan D, Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN:978-0-470-85603-1.
6. A laboratory Course in Nanoscience and Nanotechnology (2014) Poinern GEJ, CRC press, ISBN: 978-1482231038.

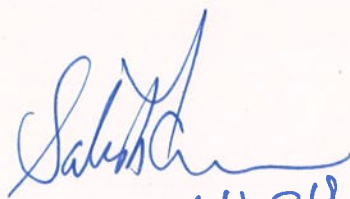
SEMESTER – III

Course title: Seminar

Course code: SIAL BT 1 3 07 C 0202

Credit: 2

Seminar will be of 45-minute duration during which the presentation will be followed by questions session by the audience comprising of faculty and students. Every student shall be required to submit the topic of his/her seminar in consultation with the Head of the Department/Faculty members/student advisors well in advance so that the same may be displayed on the notice board. The presenter has to write an Abstract to be distributed during Seminar in addition to two copies of write-up giving relevant details of the background of the subject, methods used and references/List of sources from where the material for presentation has been collected.


12/6/2009

SEMESTER – III

Course title: Animal Biotechnology

Course code: SIAL BT 1 3 04 DCEC 4004

Credit: 4

Lectures: 60

Course objective: This course is an introduction to the theory, standard practices, and methodologies of animal biotechnology.

Learning Outcomes:

- Understanding animal tissue culture techniques, gene transfer and gene manipulation methods, and transgenic animal technology.

Unit-I

Biology and characterization of cultured cells- cell adhesion, proliferation, differentiation, morphology of cells and identification. Basic technique of mammalian cell culture *in vitro*. Measuring parameters of growth in cultured cells, cell viability and cytotoxicity. Germplasm conservation and establishment of gene banks. Large-scale culture of cell lines- monolayer, suspension and immobilized cultures.

Unit-II

Organ and histotypic culture- technique, advantages, limitations, applications. Biotransformation - Induction of cell line mutants and mutations. 3D cultures. Whole embryo culture. Somatic cell hybridization. Stem cells: types (embryonic, adult), isolation, identification, expansion, differentiation and uses, stem cell engineering, ethical issues. Commercial applications of animal tissue culture. Hazards and safety aspects of tissue culture.

Unit-III

Manipulation of animal reproduction and characterization of animal genes Manipulation of reproduction in animals. Artificial insemination, embryo transfer, in-vitro fertilization. Embryo transfer in cattle and applications. Somatic cell cloning - cloning of Dolly. Ethical issues. Production of recombinant vaccines. Probiotics for disease control.

Unit-IV

Vectors for gene transfer in animals: retrovirus. Gene constructs- promoter/enhancer sequences for transgene expression in animals. Selectable markers for animal cells- thymidine kinase, dihydrofolatereductase, CAT. Transfection of animal cells- calcium phosphate coprecipitation, electroporation, lipofection, peptides, direct DNA transfer, viral vectors, microinjection. Methods for producing transgenic animals- retroviral, microinjection, engineered stem cell. Targeted gene transfer. Transgene integration and identification methods. Transgenic and genome edited animals. Ethical issues in transgenesis.

Suggested readings:

1. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Keith Wilson & John Walker, Cambridge University Press, ISBN No: 131661476X.
2. Principles of gene manipulation (2016), 8th ed. Primrose Twyman and Old. Blackwell Science, ISBN: 1405135441.
3. Animal Biotechnology (2013) Verma A and Singh A, Elsevier, ISBN: 9780124160026.
4. Molecular Biotechnology (2009), 4th ed. Glick and Pasternak, ASM Press, ISBN10: 1555814980.
5. Recombinant DNA (2006) 3rd ed., Watson JD, Richard M. Meyers, Amy AC, Jan AW, Cold Spring Harbor Laboratory Press, ISBN: 0716728664.

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SEMESTER – III

Course title: Agriculture Biotechnology

Course code: SIAL BT 1 3 05 C 4004

Credit: 4

Lecture: 60

Course objective: To provide knowledge of standard practices, methodologies and applications of biotechnology in agriculture.

Learning Outcomes:

- Understanding the classical and modern approaches of plant/crop breeding
- Understanding the manipulation of plants for improved traits responsible for stress tolerance and nutrition fortification
- Understanding of preservation and protection of plants/crops

Unit-I

Conventional methods for crop improvement (pedigree, heterosis and mutation breeding), limitations of conventional breeding, plant Genome – nuclear and cytoplasmic, significance of organelle genomes, genome size and sequence components, molecular markers: definition, properties, types of molecular markers: restriction based and PCR based, RFLP, AFLP, development of SCAR and SSR markers, other markers: CAPS, SNP, Marker Assisted Selection (MAS), screening and validation, trait related markers and characterization of genes involved.

Unit-II

Plant growth regulators; mode of action, effects on *in vitro* culture and regeneration; in-vitro storage organ formation; callus culture, suspension culture- batch and continuous culture, Protoplast culture, somatic hybridization. micropropagation, Meristem culture, Shoot tip culture and production of virus free plants, somaclonal variations, in-vitro production of haploid plants – androgenesis and gynogenesis, doubled haploid production through distant hybridization, *in-vitro* and *in-vivo* pollination and fertilization, embryo culture, embryo rescue, somatic embryogenesis, artificial seeds, germplasm conservation and cryopreservation.

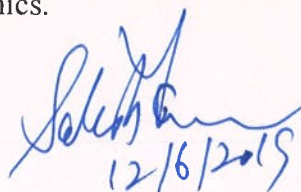
Unit-III

Mapping genes on specific chromosomes, QTL mapping, gene pyramiding, transcript mapping techniques, development of ESTs, the concept of gene synteny, the concept of map-based cloning and their use in transgenics, Antisense RNA technology- FlavrSavr Tomato, biopesticides in agriculture (botanicals and microbials), integrated pest management, Production and applications of biofertilizers (bacterial, fungal and algal); Plant secondary metabolites: Control mechanisms and manipulation of alkaloids and industrial enzymes (Shikimate and PHA pathway), importance of secondary metabolites in agriculture.

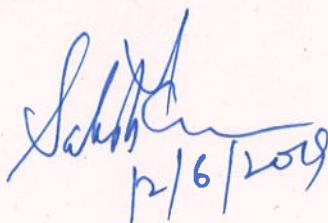
Unit - IV

Genetic engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake, Genetic engineering for biotic stress tolerance (Insects, fungi, bacteria, viruses, weeds). genetic engineering for abiotic stress tolerance (drought, flooding, salt and temperature). genetic engineering for quality improvement of protein, lipids, carbohydrates, vitamins (e.g. Golden Rice) & mineral nutrients, production of antibody in plants; Plant genetic resources, GATT & TRIPS, Patenting of biological material, patenting of transgenic organisms and genes, Plant breeders rights (PBRs) and farmers rights, Concerns about GM crops – environmental, biosafety and ethics.

Suggested readings:


12/6/2015

1. Introduction to plant Biotechnology (2018) 3rd ed., Chawla HS, CRC Press, ASIN: B07LH5S4P3.
2. Applied Biotechnology in Genetic Engineering, Pharmaceuticals and Agriculture (2016) Adam J, Syrawood Publishing House, ISBN: 978-1682862766.
3. Molecular Markers in Plants (2012), Henry RJ, Wiley-Blackwell. ISBN: 978-0-470-95951-0.
4. Genetic Transformation of Plants-Series: Molecular Methods of Plant Analysis (2013) Vol. 23, Jackson JF and Linskens HF, Springer, ASIN: B000PY3TJ0.
5. Plant Biotechnology – The genetic manipulation of plants (2017) 3rd ed., Slater A, Scott N and Fowler M, Oxford University Press. ISBN: 1138407674.
6. Plant Transformation Technologies (2011), 1st ed., Stewart CN and Touraev, A Wiley-Blackwell. ISBN: 9780813821955.


12/6/2019

SEMESTER – III

Course title: Food Biotechnology

Course code: SIAL BT 1 3 06 DCEC 4004

Credit: 4

Lectures: 60

Course objective: To develop the understanding of biotechnological applications in food fortification and food processing

Learning outcomes:

- Understand food fermentation for improved nutrition
- Understand novel food additives and supplements
- Understand mechanism and process of food spoilage and its preservation
- Understand monitoring of food quality and packaging of food

Unit-I

Introduction: microorganisms in food-historical developments, food fermentation Technology: origin, scope and development of fermented products, primary feed stock, raw materials and conversions, fermented food and microbial starters, commercial potential, food fermentation industries, their magnitude, R&D innovations.

Unit-II

Development of novel food and food Ingredients: Single cell protein, polysaccharides, low calorie sweeteners, naturally produced flavor modifiers, amino acids, vitamins, food supplements, food coloring, nutraceuticals, water binding agents. Bioreactors in food fermentations: Cultivation of microorganisms, instrumentation regulation and process control, laboratory scale submerged and solid state fermentation, pilot scale submerged and solid state fermentation.

Unit-III

Food spoilage and preservation: general principle of spoilage, microbial toxins (endotoxins and exotoxins), contamination and preservation, factors affecting spoilage. Methods of food preservation (thermal processing, cold preservation, chemical preservatives & food dehydration); Role of radiations in food preservation, characteristics of radiation of interest in food preservation. Principles underlying the destruction of microorganisms by irradiation. Effect of irradiations on food constituents. Legal status of food irradiation.

Unit-IV

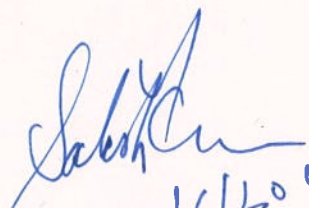
Biological controls and monitoring of food quality, packaging of food: Need for packaging, requirements for packaging, containers for packaging (glass, metal, plastics, molded pulp and aluminium foil), dispensing devices.

Suggested readings:

1. Introduction to Food Biotechnology (2018) Johnson-Green P, CRC Press, ISBN: 0815351100.
2. Fundamentals of Food Biotechnology (2015) Lee BH, Willey, ISBN: 9781118384954.

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3. Food Biotechnology Principles and Practices (2013) Joshi VK, Singh RS, Ik International Publishers Pvt. Ltd., ISBN: 9789381141496.
4. Food Microbiology: Fundamentals and Frontier (2012) 4th ed. Beuchat, D and Montville. ASM Press, ISBN: 9781555816261.
5. Biotechnology: Food Fermentation (2009) Vol. I & II. Eds. Joshi, VK and Pandey, A (1999) Educational Publishers and Distributors, Kerala. ISBN: 9788187198055
6. Modern Food Microbiology 6th ed., Jay, J.M. (2000). Kluwer Academic/Plenum publisher, ISBN: 978-0-387-23413-7.


12/6/2019

SEMESTER-III

Course title: Protein Engineering
Course code: SIAL BT 1 3 02 C 4004

Credit: 4
Lectures: 60

Course objectives: To introduce different methods and strategies commonly used in protein engineering

Learning outcomes:

- Understanding analysis of structure and function of proteins
- Understanding importance of critical amino acids involved in catalysis, stability and regulation of proteins
- Understanding protein evolution using genetic engineering approaches with improved biochemical properties

Unit-I

Protein structures; Forces stabilizing proteins – Van der waals, electrostatic, hydrogen bonding and weakly polar interactions, hydrophobic effects; Protein engineering – definition, applications; Features or characteristics of proteins that can be engineered (definition and methods of study) – affinity and specificity; Spectroscopic properties; Stability to changes in parameters as pH, temperature and amino acid sequence, aggregation propensities, *etc.* Protein engineering with unnatural amino acids and its applications.

Unit-

Methods of measuring stability of a protein; Spectroscopic methods to study physicochemical properties of proteins: UV spectrophotometry; CD spectroscopy; Fluorescence spectroscopy; Hydrodynamic properties–viscosity, Dynamic light scattering; hydrogen-deuterium exchange; Brief introduction to NMR spectroscopy-emphasis on parameters that can be measured/obtained from NMR and their interpretation.

Unit-III

Computational approaches to protein engineering: sequence and 3D structure analysis, Active site residues and modifying agents; Data mining, Ramachandran map, Mechanism of stabilization of proteins from psychrophiles, mesophiles and thermophiles.


Unit-IV

Experimental methods of protein engineering: Rational and directed evolution; Module shuffling; Guided protein recombination, Basics of optimization and high throughput screening Application to devices with bacteriorhodopsin as an example; Applications to vaccines.

Suggested readings:

1. Protein-Protein Interactions: Techniques and Applications (2018) O'Neill PB, Larsen and Keller Education, ISBN: 978-1635496536.
2. Protein Engineering and Design (2017) Torres A, Syrawood Publishing House, ISBN: 978-1682864029.
3. Protein Engineering Techniques: Gateways to Synthetic Protein Universe (2016) 1st ed., Poluri KM and Gulati K, Springer; ISBN: 978-9811027314.
4. Handbook of Protein Engineering (2015) 2nd ed., Callisto TA, ISBN: 978-1632394101
5. Protein Engineering (Nucleic Acids and Molecular Biology) (2010) Koehrer C and RajBhandary UL, Springer, ISBN: 978-3642089923

6. Protein Engineering, Principles and Practice (2006) Cleland JL and Craik CS, Vol 7, Springer Netherlands. ISBN: 978-0471103547.
7. Structure in Protein Chemistry (2006) 2nd ed. Kyte J, Garland publishers, ASIN: B013J9NXQG.


12/06/2019

SEMESTER-IV

Course title: Dissertation

Credit: 20

Course code: SIAL BT 1 4 01 SEEC 0020

Guidelines for Project File

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The file is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated goals.
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen that may be useful to document for future reference.
- The guidelines and format for dissertation is given below:

Dissertation Guidelines

1. GENERAL :

The manual is intended to provide broad guidelines to the M.Sc. candidates in the preparation of the dissertation report. In general, the project report shall report, in an organised and scholarly fashion an account of original research work of the candidate leading to the discovery of new facts or techniques or correlation of facts already known.

2. NUMBER OF COPIES TO BE SUBMITTED:

Students should submit three copies to the Head of the Department concerned on or before the specified date.

3. ARRANGEMENT OF CONTENTS OF DISSERTATION:

Page 207

Dissertation material should be arranged as follows:

1. Cover Page & Title page
2. Declaration
3. Certificate
4. Abstract (Hindi and English)
5. Acknowledgements
6. Table of Contents
7. List of Tables
8. List of Figures
9. List of Symbols, Abbreviations and Nomenclature (Optional)
10. Chapters
11. References
12. Appendices
13. One page CV

The Tables and Figures shall be introduced in the appropriate places.

4. PAGE DIMENSIONS AND MARGIN:

The dimensions of the dissertations should be standard A4 size paper may be used for preparing the copies, **standard margin** with 1.5 line spacing.

5. MANUSCRIPT PREPARATION:

The general text of thesis shall be typed in font style Times New Roman and font size 12. Same quality of paper should be used for the preparation of the entire report/thesis; except figure, photos are shown.

5.1 Cover Page & Title Page - A specimen copy of the Cover page & Title page for report/thesis are given in Annexure I.

5.2 Certificate-The Bonafide Certificate as per the format shown in Annexure II

5.3 Abstract: Abstract should be an essay type (HINDI and ENGLISH) of narration not exceeding 500 words outlining the research problem, the methodology used for tackling it and a summary of the findings, typed in 1.5 line spacing.

5.4 Acknowledgements: The acknowledgements shall be brief and should not exceed one page. The student's signature shall be made at the right bottom above his / her name typed in capitals.

5.5 Table of contents - The table of contents should list all material following it as well as any material which precedes it. The title page, Bonafide Certificate and Acknowledgment will not find a place among the items listed in the Table of Contents but the page numbers in lower case Roman letters are to be accounted for them. One and a half spacing should be adopted for typing the matter under this head. A specimen copy of the Table of Contents for report / thesis is given in Annexure III.

5.6 List of Table - The list should use exactly the same captions as they appear above the tables in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head.

5.7 List of Figures - The list should use exactly the same captions as they appear below the figures in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head

5.8 List of Symbols, Abbreviations and Nomenclature - One and a half spacing should be adopted for typing the matter under this head. Standard symbols, abbreviations etc. should be used.

5.9 Chapters - The chapters may include

Chapter I – Introduction

Chapter II - Literature Review

Chapter III –Materials and Methods

Chapter IV- Results and Discussion

5.10. Research output/outcome if any published or presented in conference/seminar/symposium may be included.

5.11. **List of References** - Any works of other researchers, if used either directly or indirectly, should be indicated at appropriate places in the report/thesis. The citation may assume any one of the following forms. **APA Style.**

APA in-text citation style uses the author's last name and the year of publication, for example: (Field, 2005).

Example:

Derwing, T. M., Rossiter, M. J., & Munro, M. J. (2002). Teaching native speakers to listen to foreign-accented speech. *Journal of Multilingual and Multicultural Development*, 23(4), 245-259.

Thomas, H. K. (2004). *Training strategies for improving listeners' comprehension of foreign-accented speech* (Doctoral dissertation). University of Colorado, Boulder.

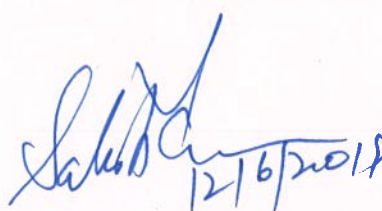
6. TYPING INSTRUCTIONS

6.1 General

This section includes additional information for final typing of the thesis. Some information given earlier under 'Manuscript preparation' shall also be referred. The impressions on the typed/duplicated/printed copies should be black in colour. Corrections, interlineations and crossing out of letters or words will not be permitted in any of the copies of the report/thesis intended for submission. Erasures, if made, should be neatly carried out in all copies. A sub-heading at the bottom of a page must have at least two full lines below it or else it should be carried over to the next page. The last word of any page should not be split using a hyphen. One and a half spacing should be used for typing the general text. The general text shall be typed in Font Style Times New Roman and Font Size 12.

Single spacing should be used for typing:

- (i) Long Tables
- (ii) Long quotations
- (iii) Foot notes
- (iv) Multilane captions
- (v) References

A handwritten signature in blue ink, followed by the date '12/6/2018' written below it.

6.2 Chapters The format for typing chapter headings, division headings and sub division headings shall be same as given in Table of Contents.

7. BINDING SPECIFICATIONS

Thesis should be spiral or soft cover book bound, the cover of thesis should be of dark greencolor, printed with golden ink and the text for printing should be identical as prescribed for the title page.

Sahin
12/6/2019

APPENDIX I A: (A typical Specimen of Cover Page & Title Page–DISSERTATION REPORT)

TITLE OF DISSERTATION REPORT

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DISSERTATION

Submitted by

<Italic>

NAME OF THE CANDIDATE

Under the Supervision of

NAME OF THE SUPERVISOR

in partial fulfillment for the award of the degree of

<1.5 line spacing>

MASTERS OF SCIENCE IN

NAME OF THE PROGRAMME

DEPARTMENT OF

SCHOOL OF

CENTRAL UNIVERSITY OF HARYANA,

MAHENDERGARH-HARYANA

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MONTH AND YEAR

[Signature]
12/6/2019

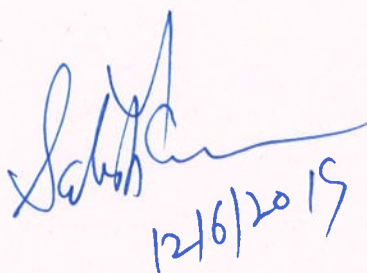
DECLARATION

I, student of the School of Interdisciplinary and Life Sciences, Central University of Haryana, Mahendergarh hereby declare and certify with my signature that my thesis entitled

..... submitted to the Department of, Central University of Haryana, India in partial fulfillment of the requirements for the award of the Degree of Masters of Science is a record of original research work done by me and the dissertation has not been the basis for the award of any degree/diploma/associateship/fellowship or similar title of any candidate of any University. I have faithfully and accurately cited all my sources, including books, journals, handouts and unpublished manuscripts, as well as any other media, such as the Internet, letters or significant personal communications.

I understand the concept of "plagiarism" and declare that while drafting this dissertation I have refrained from plagiarism. I know that plagiarism not only includes direct copying, but also the extensive use of other's ideas without proper referencing or acknowledgement (which includes the proper use of references and quotation marks).

If my dissertation found to be plagiarized at any point of time, I'll be solely responsible and will be ready to accept any decision taken by the competent authority including rejection of my dissertation.



12/6/2019

(Signature of student)

APPENDIX – I B: (A typical Specimen of Certificate)

Font Style <Times New Roman >

CENTRAL UNIVERSITY OF HARYANA

CERTIFICATE

This is to certify that the dissertation entitled “**TITLE OF THE DISSERTATION**”, submitted to the Department of, Central University of Haryana, India in partial fulfillment of the requirements for the award of the Degree of Masters of Science in is a record of original research work done by **NAME OF THE CANDIDATE (Roll No.....)** in the..... (Place of research) under my guidance. It is further certified that to the best of our knowledge the dissertation has not been the basis for the award of any degree/diploma/associateship/fellowship or similar title of any candidate of any University so far.

<<Signature of the Supervisor with date>>

<<Name of the Supervisor >>

<<Academic Designation of Supervisor>>

<<Name of Division/Centre>>

Central University of Haryana

Mahendergarh-123031

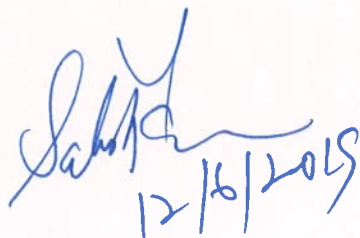

12/6/2013

For example

(A typical Specimen of Table of Contents)

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	iii
	LIST OF TABLES	xvi
	LIST OF FIGURES	xviii
	LIST OF SYMBOLS, ABBREVIATIONS	xxvii
1	INTRODUCTION	1
	1.1 GENERAL	1
	1.2 NEED FOR THE STUDY	2
	1.3 OBJECTIVES OF THE STUDY	3
2	REVIEW OF LITERATURE	4
	2.1 INTRODUCTION	4
	2.2	4
	2.2.1 Product	6
	2.2.2 Product....	6


12/6/2019

ANNEXURE II

Curriculum vitae

Personal Details

Name :

Date of birth : DD Month, YYYY

Place of birth :

Nationality : Indian

Permanent Address :

Email Id :

Mobile No. :

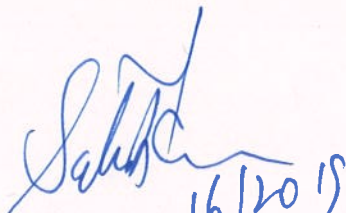
Education

M.Sc. (Subject) : YYYY Central University of Haryana, India

B.Sc. (Subject). : YYYY (Name of the University) with % of marks

Higher Secondary : YYYY (Name of the board) with % of marks

Secondary : YYYY, (Name of the board) with % of marks


12/6/2019

BOS Meeting

Annexure-V

Date: 28/02/19

Dept of Biochemistry

Proceedings of meeting of Board of Studies

held on 28/02/19 at PM

Venue: Dept of Biochemistry, CUH

Members

External: Prof S. S. Chauhan
AIIMS, DELHI

S. S. Chauhan
28/2/19

Internal: Prof Neelam Sonawar

Dr Pawan Marya (Associate prof)

Dr Sanjay Kumar (Assistant prof)

Dr Piyush Kola (invitee)

Moreover, we will seek consent from one more BOS member

Dr V K Chaudhry

DUSC

(Delhi University south campus)

Agenda

1. Panel of paper setters for upcoming TEE June 2019 for Semester ~~1st~~ 2nd
2. Panel of Examiners (external) for 4th Sem Dissertation VIVA VOCE
3. To start PhD program in Dept of Biochemistry from upcoming session August 2019
4. If in case External Examiner is not able to come, internal faculty of Biochemistry can conduct practical/viva voce
5. Revised syllabus for upcoming session i.e. July 2019 wherein 1st semester will be common for 4 Life Science Departments

Arshu
28/2/19
(Prof S.S. Chauhan)
AIIMS Dehli

P. K. Maurya
Pawan K Maurya
Associate Professor

Sanjay Kumar
Assistant Professor

P. K. Maurya
Piyush Kumar
Assistant Professor

S. S. Chauhan
13/6/19

Pawan
Associate

Recommendations:

1. Names of Paper setters was discussed and modified as per the suggestions of BOS members.
2. Panel of external examiners for 4th sem. viva was discussed and incorporated as per the suggestion.
3. PhD program curriculum was discussed with syllabus during 66 session.
4. Hsc. syllabus was discussed in much detail and all suggestion is incorporated.
5. With agenda # 4, It was recommended that it is always better to keep 1-2 external members to enhance quality of thesis and to receive constructive suggestions.

Meeting ends with thanks to chair

S. S. Chauhan
25/2/19

(Prof. S. S. Chauhan)
A IIMS Delhi

P. K. Maurya
Pawan K. Maurya
Associate Professor

Sanjay Kumar
Assistant Professor

P. J. Kumar

P. J. Kumar

School of Interdisciplinary and Applied Life sciences

Revised Scheme and Syllabi for MSc Biochemistry
(2019-2021)



Department of Biochemistry
Central University of Haryana
Mahendergarh

Department of Biochemistry
Master of Science in Biochemistry (Semester-wise Scheme 2019-2021)

Semester-I (Total credits 24)

Course code	Course title	L	T	P	Type of course	Credit
SIAL SC 1 1 01 C 3003	Cell and Molecular Biology	3	0	0	Core	3
SIAL SC 1 1 02 C 3003	Principles of Biochemistry	3	0	0	Core	3
SIAL SC 1 1 03 C 3003	General Microbiology	3	0	0	Core	3
SIAL SC 1 1 04 C 3003	Genetics	3	0	0	Core	3
SIAL SC 1 1 05 C 3003	Analytical Techniques	3	0	0	Core	3
SIAL SC 1 1 06 C 00105	Practical-I	0	0	10	Core	5
	General Elective Course (to be opted from other Department)	4	0	0	GEC	4

Semester-II (Total credits 30)

Course Code	Course Title	L	T	P	Type of Course	Credit
SIAL SC 1 2 07 C 4004	Immunology	4	0	0	Core	4
SIAL SC 1 2 09 C 4004	Genomics and Genetic Engineering	4	0	0	Core	4
SIAL BC 1 2 01 C 3003	Advance Cell and Molecular Biology	3	0	0	Core	3
SIAL BC 1 2 02 C 4004	Enzymology	4	0	0	Core	4
SIAL BC 1 2 03 C 4004	Intermediary Metabolism	4	0	0	Core	4
SIAL BC 1 2 04 C 00105	Practical-II	0	0	10	Core	5
SIAL SC 1 2 10 DCEC 2002	Research Methodology and Scientific Communication Skills*	2	0	0	DCEC	2
SIAL SC 1 2 11 DCEC 2002	Bio-entrepreneurship*	2	0	0	DCEC	2
SIAL BC 1 2 01 DCEC 4004	Cell and Tissue culture Engineering [#]	4	0	0	DCEC	4
SIAL BC 1 2 02 DCEC 4004	Neurobiochemistry [#]	4	0	0	DCEC	4

*One of the courses will be opted by the student.

[#] One of the courses will be opted by the student.

Semester-III (Total credits 30)

Course code	Course title	L	T	P	Type of course	Credit
SIAL SC 1 3 12 C 4004	Biostatistics and Bioinformatics	4	0	0	Core	4
SIAL SC 1 3 13 C 4004	Biophysics and Nanosciences	4	0	0	Core	4
SIAL BC 1 3 05 C 4004	Plant Biochemistry	4	0	0	Core	4
SIAL BC 1 3 06 C 4004	Clinical Biochemistry and Molecular Diagnostics	4	0	0	Core	4
SIAL BC 1 3 07 C 0084	Practical-III	0	0	8	Core	4
SIAL BC 1 3 08 C 0202	Interactive group discussion cum seminar (Biosafety, Bioethics and IPR)	0	2	0	Core	2
SIAL BC 1 3 03 DCEC 4004	Nutritional Biochemistry [#]	4	0	0	DCEC	4
SIAL BC 1 3 04 DCEC 4004	Pharmaceutical Biochemistry [#]	4	0	0	DCEC	4
	General Elective Course (to be opted from other Department)	4	0	0	GEC	4

[#] One of the courses will be opted by the student.

Semester-IV (Total credits 20)

Skill Enhancement Course

Course code	Course title	Type of course	Credit
SIAL BC 1 4 01 SEEC 0020	Dissertation	Core	20
Total credits of the Program			104

L- Lecture; T- Tutorial P-Practical; C- Core course; DCEC - Discipline Centric Elective Course – to be opted by the student; SEEC- Skill Enhancement Elective Course; GEC- General Elective Course.

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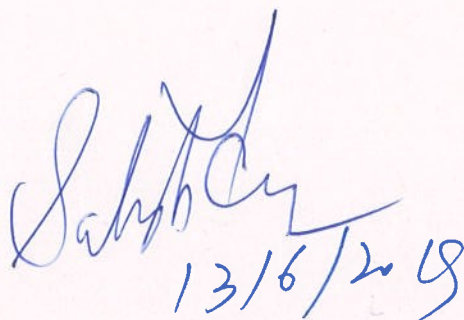
Credit Summary of Courses Offered by Department of Biochemistry
(Academic Session 2019-21)

Total Credits: 104

Semester	Credits				Total credits
	Core courses	Skill enhancement course	Elective courses		
			DCEC (For Department of Biochemistry students)	GEC (For other Department students)	
I	20	-	-	4	24
II	24	-	6	-	30
III	22	-	4	4	30
IV	-	20	-	-	20
Total	66	20	10	8	104

Generic Elective Course: Offered by Department of Biochemistry to students from other Departments of University.

Semester	Type of course	Course code	Course title	Credit
I	GEC	SIAL BC 1 1 01 GEC 4004	Clinical Biochemistry	4
		SIAL BC 1 1 02 GEC 4004	Biochemical and Environmental Toxicology	
III	GEC	SIAL BC 1 3 03 GEC 4004	Advance Molecular Biology	4
		SIAL BC 1 3 04 GEC 4004	Stem cell biology	


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SEMESTER-I

Course title: Cell and Molecular Biology
Course code: SIAL SC 1 1 01 C 3003

Credit: 3
Lectures: 45

Course objectives: To understand cellular organization and function at molecular level.

Learning Outcomes:

- Understanding of fundamental concepts of cellular and sub-cellular organization
- Molecular basis of genetic information and function

Unit-I

Archea, prokaryotic and eukaryotic cell (animal and plant cells); Theory of origin of eukaryotic cells; Structure and function of nucleus - nuclear envelope, nuclear pore complex; Nuclear protein-import and export, regulation of nuclear protein import and export; Organization of golgi, lysosome, structure and functions of ER, lysosome, mitochondria, chloroplasts and peroxisomes; Fluid mosaic model, membrane proteins, membrane lipids and membrane fluidity; Transport across cell membrane, passive transport, active transport-primary (P-type, F-type, V-type ATPases, ABC transporters), co-transport-symport and antiport; Ion channels, aquaporins, pinocytosis and phagocytosis; Cells as experimental models.

Unit-II

Introduction to cytoskeletal proteins; Organization of cytoskeletal protein and smooth muscle and skeletal muscles, movement of vesicles-role of actin and myosin; Structure of cilia and flagella; Prokaryotic and eukaryotic cell wall, cell matrix proteins; Cell-matrix interactions and cell-cell interactions; Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata; Signalling molecules, receptors and their functions – G protein coupled receptors- Cyclic-AMP, Cyclic-GMP, IP3, Calcium, Receptor tyrosine kinases - EGF, insulin.

Unit-III

DNA as genetic material, forms of DNA; structure of various type of DNA; chromatin structure; super coiling; polytene and lamp brush chromosomes; properties of DNA in solution; denaturation and renaturation; reassociation reactions; COT curves; types of RNAs and their structures; role of RNA; Unusual bases in RNA; central dogma of molecular biology; DNA polymerases and other enzymes involved in replication; mutagenesis.

Unit-IV

Prokaryotic and eukaryotic gene structure: transcription-RNA polymerase, inhibitors of transcription; proof reading function and fidelity of DNA replication; possible modes of DNA replication; theta model and rolling circle model of DNA replication; replication of DNA in eukaryotes; role of methylation; replication of viral RNA; reverse transcriptase, regulatory region and transcriptional unit of gene; post transcriptional processing of RNA: splicing, cap addition and polyadenylation, polynucleotide phosphorylase.

Suggested readings:

1. The Cell: A Molecular Approach (2018) 8th ed., Cooper, GM, Sinauer Associates is an imprint of Oxford University Press, ISBN: 1605357073.

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2. Molecular Cell Biology (2016) 8th ed., Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D and Darnell J, W.H. Freeman & Company (New York), ISBN: 978-1-4641-0981-2 / ISBN-10: 1464183392.
3. Molecular Biology of the Cell (2008) 6th ed., Alberts B, Johnson A, Lewis J and Enlarge M, Garland Science (Princeton), ISBN: 0-8153-1619-4 / ISBN-10: 0-8153-1620-8.
4. Lehninger Principles of Biochemistry (2017) 7th ed., Nelson DL, Cox MM, W.H. Freeman and Company, New York, USA. ISBN-10: 1-4641-2611-9.
5. Biochemistry (2019) 9th ed., Stryer L, Berg JM, Tymoczko JL, Gatto, Jr. GJ, W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9
6. Genes XII, (2017) 12th Revised edition ed., Lewin B, Krebs J, Kilpatrick ST, Goldstein ES, Jones and Bartlett Publishers, Inc. Sudbury, Massachusetts, USA. ISBN No. 9781284104493.
7. Molecular Biology of the Gene (2013) 7th ed., Watson JD, Baker TA, Bell SP, Gann A, M, Levin RL and Cumming B, San Francisco, ISBN: 0321905377.

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SEMESTER-I

Course title: Principles of Biochemistry

Course code: SIAL SC 1 1 02 C 3003

Credit: 3

Lectures: 45

Course objectives: To understand structures and functions of bio-molecules, metabolic pathways in the living systems.

Learning outcomes:

- Comprehensive knowledge of biochemical pathways-synthesis and catabolism of major biomolecules

Unit-I

Monosaccharides-structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers. Disaccharides: maltose, lactose and sucrose. Polysaccharides: homo and hetero-polysaccharides, structural and storage polysaccharides. Glycolysis - a universal pathway, reactions of glycolysis, production of acetyl CoA, reactions of citric acid cycle. Gluconeogenesis, glycogenesis and glycogenolysis.

Unit-II

Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes-phospholipids, glycerophospholipids, galactolipids, sulpholipids, sphingolipids and sterols. β -oxidation of fatty acids. Fatty acid synthase complex. Synthesis of fatty acids.

Unit-III

Amino acids and peptides- classification (essential and non-essential amino acids), chemical reactions and physical properties. Introduction to protein structure and function. Enzymes: classification, kinetics (significance of k_m , k_{cat} and V_{max}), inhibition; amino acid metabolism-amino acid deamination and transamination, urea cycle. Synthesis and utilization of ketone bodies. Biosynthesis and breakdown of nutritionally non-essential amino acids. Synthesis of other amino acid derivatives such as neurotransmitters.

Unit-IV

Nucleotides - structure and properties. Nucleic acid structure-Watson - Crick Model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. De novo synthesis of purine and pyrimidine nucleotides. Catabolism of purine and pyrimidine. Disorders of purine and pyrimidine metabolism.

Suggested readings:

1. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
2. Biochemistry (2017) 6th ed., Garrett RH and Grisham CM, Brooks/Cole, ISBN: 9781305577206.
3. Harper's Illustrated Biochemistry (2018) 7th ed., Rodwell VW, Bender DA, Botham KM, Kennelly, PJ and Weil PA, McGraw-Hill, ISBN: 9781259837937.
4. Lippincott's Illustrated Reviews Biochemistry (2017) 7th ed., Ferrier, Wolters Kluwer India Pvt. Ltd., ISBN: 978-9351297949.
5. Biochemistry (2019) 9th ed., Stryer L, Berg JM, Tymoczko JL, Gatto Jr. GJ, W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9.

SEMESTER-I

Course title: General Microbiology
Course code: SIAL SC 1 1 03 C 3003

Credit: 3
Lecture: 45

Course objective: To provide an understanding of basic concepts and techniques in Microbiology.

Learning outcomes:

- Demonstrate the practical skills in basic microbiological techniques
- Designate the role of microorganisms in different ecosystems
- Retrieve and use contemporary information on different microbial groups

Unit-I

History of development of Microbiology in 20th century; The spontaneous generation controversy; Germ theory of disease; Methods in microbiology: Physical and chemical methods of sterilization; Pure culture techniques, maintenance and preservation of microbial cultures.

Unit-II

Binomial nomenclature; Haeckel's three kingdom classification; Organization of archae, bacteria and eukaryotic cell; Use of DNA and r-RNA sequencing in classification of microorganisms; Woese's three kingdom classification system and its utility - archaea, eubacteria, eukarya; Different groups of acellular microorganisms - viruses, viroids and prions.

Unit-III

General features of microorganisms - bacteria, algae, fungi and protozoa; Bacterial growth and metabolism; Microbes in different environment: extreme environment, deep ocean, space and air. Special features of the thermophilic, methanogenic and halophilic bacteria; Photosynthetic bacteria, cyanobacteria.

Unit-IV

Scope of Microbiology - Cycle of matter in nature; Microbial interactions – Symbiosis and parasitism; Biodegradation and Bioremediation; Biofilms; Microbes in composting; Biofertilizers and Biopesticides; Microbes and Industry - SCP, microbial enzymes and fermented foods, Vaccines and antibiotics.

Suggested readings:

1. An Introduction to Microbiology (2019) 3rded., Tauro P, Kapoor KK, Yadav KS, and Sequeira MG. New Age International Publishers. ISBN: 0852268785.
2. Brock Biology of Microorganisms (2018) 15thed., Madigan MT, Martinko JM, Bender KS, Buckley DH, Stahl DA, Pearson Education, ISBN 9781292235103.
3. Prescott's Microbiology (2017) 10th ed. Sherwood LM, Woolverton C.J McGraw-Hill Education. ISBN 9781259281594.
4. A text book of Microbiology (2013) 3rd ed. Dubey, R.C. and Maheswari, D.K. Revised S. Chand and Company Ltd, New Delhi. ISBN: 9788121926201.
5. Microbiology (2001) 5th ed., Pelczar Jr. M, McGraw Hill Education ISBN: 9780074623206.

SEMESTER-I

Course title: Genetics

Course code: SIAL SC 1 1 04 C 3003

Credit: 3

Lecture: 45

Course objective: To study the fundamental concepts of genetics and its role in unification of different disciplines of biology.

Learning outcomes:

- Understanding of basic concepts of classical genetics and genetic analysis of eukaryotes

Unit-I

Historical background, Principles of Mendelian inheritance, codominance, incomplete dominance, Gene interactions, pleiotropy, Extra chromosomal inheritance: Maternal inheritance (mitochondria and chloroplast), Sex linked inheritance, Sex influenced and Sex limited traits, Gene interactions: Incomplete dominance, codominance, duplicate genes, complementary genes, supplementary genes, lethal genes, pleiotropic genes and multiple alleles.

Unit-II

Linkage: complete and incomplete linkage, linkage analysis and genetic maps, Linkage and recombination of gene, Mechanism of crossing over, Population Genetics and Hardy-Weinberg equilibrium. Genetic analysis: Linkage maps, mapping with molecular markers, Gene mapping by three point test cross, Tetrad analysis, Sex determination and Dosage compensation in Mammals and Drosophila, Quantitative Genetics: Multilocus control; QTL analysis; Quantitative inheritance in plants and human.

Unit-III


Mutations: concept and types, Mechanism of spontaneous mutations, Physical and chemical mutagenesis, Selection and enrichment of mutants, Molecular mechanism of induced mutations, importance of mutation; detection of mutation and directed mutagenesis, Germinal and somatic mutation, insertion, deletion, duplication, translocation, transposition, Numerical alterations of chromosomes: Ploidy and their genetic implications. Types of DNA repair, Molecular mechanism of suppression.

Unit-IV

Nucleosome and chromatin structure, Structure of centromere and telomere, Euchromatin and heterochromatin, Polytene and lamp brush chromosomes, Gene transfer in prokaryotes: Transformation, Conjugation and Transduction, Transposons: types, structures and role in gene regulation, Natural and artificial competence, Operon concept in bacteria and gene regulation, Bacterial plasmids, Lytic and lysogenic cell cycles in Phages.

Suggested readings:

1. Principles of Genetics (2006) 8th ed. Gardner EJ, Simmons, MJ and Snustad DP, John Wiley & Sons Inc, ISBN: 8126510439.
2. Essentials of Genetics (2015) 9th ed. William S, Michael K, Cummings R, Spencer, CA and Palladino MA, Prentice Hall Internationals, ISBN-10: 0134047796
3. Genetics (2017) 9th ed. Daniel L. Hartal & B. Cochrane, ISBN: 128412293X
4. Introduction to Quantitative Genetics (1995) Falconer DS, and Mackay TFC, ISBN: 0582243025.



5. An Introduction to Population Genetics Theory and applications (2013) Nielsen R and Slatkin M, Oxford University Press, ISBN: 1605351539.
6. Evolution 4th ed. (2017) D. Futuma and M. Kirkpatrick, ISBN: 9781605356051
7. An Introduction to Genetic Analysis (2015) Griffith AJFJ, Wessler SR, Carroll SV and Doebley J, ISBN: 0-7167-3520-2.



SEMESTER-I

Course title: Analytical Techniques
Course code: SIAL SC 1 1 05 C 3003

Credit: 3
Lecture: 45

Course objective: To provide an advanced understanding of the core principles of various techniques used in biological experiments.

Learning outcomes:

- Demonstrate principles of various basic and advanced techniques used in biological experiments
- Critically analyze and interpret the results obtained from biological experiments

Unit-I

Principle of microscopy: resolving powers of different microscopes, magnification; different types of microscopes, principle and applications of compound microscopy, dark microscopy, fluorescence microscopy, phase contrast microscopy, confocal microscopy, atomic force microscopy and electron microscopy (SEM, TEM, STEM); fixation and staining, freeze fracture/etch techniques.

Unit-II

Agarose gel electrophoresis, polyacrylamide gel electrophoresis (native PAGE and SDS-PAGE); Western transfer, iso-electric focusing (IEF), 2-Dimensional gel electrophoresis, pulse field electrophoresis; principle and applications of centrifugation, differential centrifugation, density gradient centrifugation and ultracentrifugation; cell separation by flow cytometry.

Unit-III

Paper chromatography (ascending and descending, 2-Dimensional); principle and applications of thin layer chromatography (TLC), column chromatography (gel filtration, ion exchange and affinity chromatography); methods of ligand immobilization, immuno-adsorption-hydrophobic interaction chromatography, metal chelate chromatography, covalent chromatography, high performance liquid chromatography (HPLC) and gas liquid chromatography (GLC).

Unit-IV

Principle and instrumentation of UV-visible, infrared spectroscopy, atomic absorption spectrophotometry, NMR spectroscopy, X-ray diffraction spectroscopy, N-terminal sequencing and peptide synthesis, introduction to proteomics, Yeast 2- hybrid and 3-hybrid systems, EMSA, foot printing, phage display, principle of mass spectrometry, electrospray ionization MS, MALDI, tandem MS for protein identification, ICAT-MS.

Suggested readings:

1. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Wilson K and Walker J, Cambridge University Press, ISBN No. 131661476X.
2. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder D, W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.

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SEMESTER – I

Course Title: Practical-I

Course Code: SIAL SC 1 1 06 C 00105

Credit: 5

Lecture: 150

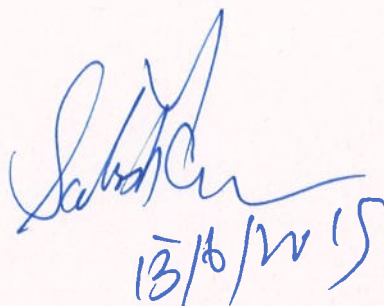
1. Laboratory orientation, calibration, and demonstration of equipment.
2. Solutions, pH and buffers
3. Determination of pKa of acetic acid and glycine
4. Qualitative tests for carbohydrates, lipids, amino acids, and proteins in food samples
5. Metaphase chromosome preparation with G banding and C banding from blood sample
6. RNA *in-situ* hybridization to study gene expression in tissue section
7. Inheritance patterns in man – numerical on pedigree analysis- autosomal patterns, X-linked patterns, Y-linked patterns, mitochondrial inheritance patterns
8. Numerical on Hardy-Weinberg equilibrium
9. Numerical on linkage mapping
10. Different staining methods and microscopic examination of bacteria, actinomycetes, algae, fungi and protozoa
11. Preparation of specific media for isolation of bacteria, and fungi from natural sources
12. Cell counting and cell viability assay
13. Production of microbial enzymes (amylase, phosphatase) and their separation using chromatographic techniques
14. Biochemical characterization of microbial enzymes.
15. Separation of carbohydrates, amino acids and plant pigments using paper/thin layer chromatography
16. Detection of food adulterants
17. Evaluation of microbiological risks in food processing unit through microbiological risk assessment (MRA) tools
18. Assessment of nutritional status of different age group using anthropometric tools

Suggested readings:

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D, Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.
2. An Introduction to Practical Biochemistry (2017) 3rd ed., Plummer, D.T., McGraw Hill Education, ISBN: 978-0070994874.
3. Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed. Wilson K, and Walker J, Cambridge University Press. ISBN: 131661476X.
4. Microbes in Action: A Laboratory Manual of Microbiology (1990) 4th ed., Harry W, Seeley, Paul JV, John J, W. H. Freeman ISBN: 978-0716721000.
5. Genetics: A Laboratory Manual, (2009) 2nd ed., American Society of Agronomy; Lab Manual edition, ISBN: 978-0891185611.

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6. Infant, Child and Adolescent Nutrition: A Practical Handbook (2013) 1st Addition, More J, CRC Press, ISBN: 9781444111859.
7. Laboratory Manual of Microbiology and Biotechnology (2014) 1sted. Aneja KR, Scientific International Pvt., Ltd. ISBN: 9789381714553.
8. Microbiology: A Laboratory Manual (2017), 11th ed., Cappuccino, JH, Sherman, N., Pearson Education Inc, ISBN: 9780134298597.
9. An Introduction to Practical Biochemistry (2017) 3rd ed., Plummer, DT, McGraw Hill Education, ISBN: 978-0070994874.


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SEMESTER-I

Course title: Clinical Biochemistry
Course code: SIAL BC 1 1 01 GEC 4004

Credit: 4
Lectures: 60

Course objective: The objectives of this course are to demonstrate how basic biochemistry and analytical chemistry can be applied to medical diagnosis, treatment and management.

Learning outcomes:

- Clinically assess the laboratory indicators of physiologic conditions and diseases
- Understanding the biochemical and molecular tools needed to accomplish diagnostic, and therapeutic intervention on hereditary and acquired disorders
- Understanding the importance of quality control and assurance to diagnostic work

Unit-I

Clinical Biochemistry - concept, definition and scope; biological samples - types, collection, processing, stability and storage; phlebotomy; serum and serum separator devices; chemical composition of biological fluids - blood, urine and cerebrospinal fluid; reference ranges.

Unit-II

Quality assurance; accuracy and precision; factors influencing the accuracy of results; Levy-Jennings's chart; reliability of a laboratory method; interferents; responsibilities of a clinical biochemist.

Unit-III

Biochemical tests in clinical practice – characteristics and uses of a biochemical test; criteria for selecting a method for biochemical analysis; enzymes as diagnostic tool; advantages and disadvantages of enzyme assays; isozymes and their diagnostic importance; methods for the detection of isoenzymes.

Unit-IV

Organ function tests - clinical presentation and diagnosis of the diseases of the liver and kidney; bilirubin metabolism; acid base disorders.

Suggested readings:

1. Clinical Biochemistry (2018) 6th ed., Murphy M, Srivastava R and Deans K, Elsevier, ISBN: 978-0702072987.
2. Clinical Biochemistry: Metabolic and Clinical Aspects (2014) 3rd ed., Marshall WJ, Churchill Livingstone, ISBN: 978-0702051401.
3. Clinical Biochemistry (Lecture Notes) (2017) 10th ed., Rae P, Crane M and Pattenden R, Wiley-Blackwell, ISBN: 111924868X.
4. Lecture Notes: Clinical Biochemistry (2010) 8th ed., Becket G, Walker SW, Race P and Ashby P, Wiley-Blackwell, ISBN: 978-1405193054.
5. Principles of Medical Biochemistry (2016) 4th ed., Meisenberg G and Simmons WH, Elsevier, ISBN: 978-03232 96168.
6. Tietz Fundamentals of Clinical chemistry and Molecular diagnostics. (2014) 7th ed., Burtis CA and Bruns DE, Elsevier, ISBN: 978-8131238851.

SEMESTER-I

Course title: Biochemical and Environmental Toxicology

Credit: 4

Course code: SIAL BC 1 1 02 GEC 4004

Lectures: 60

Course objective: To study the fundamental concepts, methods, approaches of Biochemical and environmental toxicology.

Learning outcomes:

- Identifying a variety of environmental toxicants in terms of their occurrence and toxic effects
- Understanding the fate and transport of toxicants in the environment and how these processes affect their toxicity
- Understanding the toxicological effects of biochemical and environmental toxicants on humans

Unit –I

Definition and scope of toxicology, eco-toxicology and its environmental significance. Toxic effect: Basis for general classification & nature. Dose – Response relationship: synergism and antagonism, determination of ED_{50} & LC_{50}/LD_{50} , minimum effective dose (MED), minimum tolerance dose (MTD). Acute and chronic exposures. Factors influencing toxicity.

Unit-II

Xenobiotic metabolism: absorption & distribution. Phase I reaction. Oxidation, reduction, hydrolysis and hydration. Phase II reaction/conjugation: methylation, glutathione, glucouronic acid and amino acid conjugation. Detoxification. Biochemical basis of toxicity: distribution of Excitable membrane function. Altered calcium homeostasis. Covalent binding to cellular macromolecules & genotoxicity. Tissue specificity of toxicity. Toxicity testing: in-vitro test systems- bacterial mutation test: reversion test, Ames test, fluctuation tests. Comet assay. Chromosome damage tests.

Unit-III

Food Toxicology: role of diet in cardio-vascular disease and cancer. Toxicology of food additives. Metal toxicity: Toxicology of arsenic, mercury, lead and calcium. Environmental factors affecting metal toxicity – effect of light, temperature and pH.

Unit-IV

Diagnosis of toxic changes in liver and kidneys: metabolism of haloalkanes, haloalkenes and paracetamol with their toxic effects on tissues. Air pollution: common air pollutant & their sources. Air pollution and ozone. Air pollution due to chlorofluorocarbons (CFCs) and asbestos. Water pollution; major water pollutants. Effects of selected pollutions on fresh water flora & fauna. Effect of UV radiation on human health.

Suggested readings:

1. Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes (2017) 5th ed., Landis WG, Sofield RM and Yu MH, CRC Press, ISBN: 978-1498750424.
2. Environmental Toxicology: Biological and Health Effects of Pollutants (2011) 3rd ed., Yu MH, Tsunoda H and Tsunoda M, CRC Press, ISBN: 978-1439840382.
3. Environmental Toxicology Current Developments (2014) 1st ed., Rose J, Taylor and Francis, ISBN: 0203-30551-5.

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4. An Introduction to Environmental Toxicology (2018) 4th ed., Dong MH, Create space Independent Publishing platform, ISBN: 1979904510.
5. Foodborne Microbial Pathogens: Mechanisms and Pathogenesis (2018) 2nd ed., Bhunia AK, Springer Nature, ISBN: 978-1493973477.

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SEMESTER-II

Course title: Immunology

Course code: SIAL SC 1 2 07 C 4004

Credit: 4

Lecture: 60

Course objective: To understand overall organization of the immune system and to identify the cellular and molecular basis of immune responsiveness.

Learning outcomes:

- Understanding the working mechanism of the immune system
- Understanding of antibody, MHC, complement system, cytokines, cancer, and organ transplant hypersensitivity

Unit-I

Host-defenses, hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT). Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, chemokines. Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

Unit-II

Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family. Multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification. Antigen independent phase of B cell maturation and selection, humoral response – T-dependent and T-independent response.

Unit-III

Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies. General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, pathways of antigen processing and presentation. Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation. General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

Unit-IV

Mechanism of tolerance, Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity. Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy, Immunohistochemistry, Immunocytochemistry and privileged sites. Vaccines - active and passive immunization, types of vaccines.

Suggested readings:

1. Kuby Immunology (2018) 8th ed., Punt J, Stranford S, Jones P and Owen JA, W.H Freeman and Company, ISBN: 978-1319114701.
2. Janeway's Immunobiology (2017) 9th ed., Murphy KM and Beaver C, WW Norton and Company, ISBN: 978-0815345510.
3. Roitt's Essential Immunology (2017) 13th ed., Delvis PJ, Martin SJ, Burton DR and Roitt, IM, Wiley-Blackwell, ISBN: 978-1118415771.

4. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
5. Lippincott's illustrated Reviews Immunology (2012) 2nd ed., Doan T, Melvold R, Viselli S and Waltenbaugh, C, Wolters Kluwer India Pvt, Ltd, ISBN: 978-8184737639.

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SEMESTER-II

Course title: Genomics and Genetic Engineering

Course code: SIAL SC 1 2 09 C 4004

Credit: 4

Lecture: 60

Course objective: To provide basic and high throughput techniques in the areas of genomics and genetic engineering.

Learning outcomes:

- Understanding of high throughput techniques used in genomics and transcriptomics
- Understand concept of genetic engineering including the techniques, applications and limitations
- Demonstrate the ability of designing recombinant molecules and conducting experiments involving genetic manipulation

Unit-I

Origin of genomics: The first DNA genomes, Structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes, Microbial genomes (including yeast), Plant genomes (Arabidopsis and rice), Animal genomes (fruit fly, mouse, human), Genomes and human evolution, The concept of minimal genome. Genetic maps, Physical maps, EST and transcript maps, Functional maps and Functional genomics, Human genome project-landmarks on chromosomes generated by various mapping method, Comparative genomics and colinearity/syntenin maps, Genetic variation polymorphism, deleterious mutation; FISH to identify chromosome landmarks.

Unit-II

BAC libraries and shotgun libraries preparation (shotgun sequencing); Clone-by-clone or 'hierarchical shotgun' Sequencing, Next Generation sequencing, Genomics in medical practice, personalized medicine, use of SNP in pharmacogenomics, DNA Microarray technology: Basic principles and design, Global gene expression analysis, Comparative transcriptomics, Differential gene expression

Unit-III

Recombinant DNA Technology: Enzymes used in Recombinant DNA technology (Restriction endonucleases, DNA modifying enzymes, other nucleases, Polymerases, Ligase, kinases and phosphatases), Isolation and purification of DNA (genomic and plasmid) and RNA. Various methods of separation, characterization of nucleic acids including Southern and Northern hybridizations, Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors and their purification.

Unit-IV

Western blotting, Generation of genomic and cDNA libraries. Plasmid, Phage, Cosmid, BAC and YAC vectors. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms. Isolation and amplification of specific nucleic acid sequences, PCR, RT PCR and qRT PCR, DNA sequencing methods, strategies for genome sequencing. Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques. Site-directed mutagenesis, protein engineering. Applications of genetic engineering in plants and animal improvements.

Suggested readings:

1. Principles of Gene Manipulation and Genomics (2016) 8th ed., Primrose, SB and Twyman, R, Wiley Blackwell, ISBN 13: 978-1405156660.
2. Gene Cloning and DNA Analysis: An Introduction (201978-6) 7th ed., Brown, TA, Wiley Blackwell, ISBN 13: 978-1119072560.
3. Genome 4 (2017) 4th Brown, TA, Garland science, ISBN 13: 978-0815345084.
4. Introduction to Genomics (2015) 2nd ed., Lesk, AM, Oxford university Press India, ISBN 13: 978-0198745891.
5. Genomics and Personalized Medicine: What Everyone needs to Know (2016) 1st ed., Snyder, M, OUP-USA, ISBN 13: 978-0190234768

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SEMESTER-II

Course title: Advance Cell and Molecular Biology
Course code: SIAL BC 1 2 01 C 3003

Credit: 3
Lectures: 45

Course objective: To demonstrate knowledge and understanding of the molecular machinery of living cells.

Learning outcomes:

- Understanding sorting and transport of protein to ER and targeting of protein to other organelles
- Outlining the processes that control eukaryotic cell cycle and cell death
- Understanding the structural organization of genes and the control of gene expression, DNA replication, Transcription and Translation process

Unit-I

Selective transport of proteins to and from the nucleus. Targeting proteins to ER, smooth ER and lipid synthesis. Quality control in ER, targeting of protein to other organelles. Export of proteins and lipids from ER and into ER. Lipid and polysaccharide metabolism in Golgi, protein sorting and export from Golgi. Mechanism of vesicular transport, cargo selection, coat proteins and vesicle budding, vesicle fusion. Protein import and mitochondrial assembly, protein export from mitochondrial matrix. Import and sorting of chloroplast proteins.

Unit-II

Eukaryotic cell cycle, restriction point, and checkpoints. Cell division. Apoptosis and necrosis - brief outline. Cancer; characteristics of tumor cells, oncogenes, tumor suppressor genes. Ras and Raf, MAP kinase pathway, JAK/STAT Pathway.

Unit-III

Translation; adapter role of RNA in protein synthesis; size of the code; methods of deciphering the genetic code; code word dictionary; general features of the genetic code; identification of anticodons; wobble hypothesis; ribosome as the site of protein synthesis; polysomes ; activation of amino acids; initiation, elongation and termination of protein synthesis in prokaryotes and eukaryotes. Control of translation: role of guanine nucleotides; translational control of gene expression, Gel retardation assay (EMSA), DNA finger printing, post-translational processing of the polypeptide chains; acetylation, methylation, phosphorylation by protein kinases; sulfation; glycosylation.

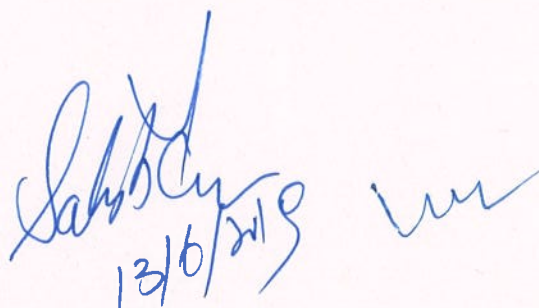
Unit-IV

Gene expression in prokaryotes; enzyme induction and repression; negative and positive control; concept of operon; catabolite repression; transcriptional termination control via mRNA alternative conformations; regulation of gene expression in eukaryotes; promoters, enhancers, silencer and response elements; regulation at transcriptional level: Britten Davidson Model; control by steroid hormones. Role of chromatin structure in gene expression; cytoplasmic regulation of gene expression; role of splicing and alternate splicing in regulation of gene expression, organelle genome; epigenetics. Mutation. Various types of mutations. Spontaneous mutation and induced mutation. Reversion of mutations. Conditional mutation. Induced mutations. Radiation induced mutation. Effect of UV. Chemically induced mutation. Mutagenesis. Site directed mutagenesis. Oligonucleotide directed site mutagenesis.

Mutagenicity of a chemical substance. Ames Test. DNA damage and repair. Types of DNA damage. Deamination. Depurination. Thymine dimer formation. Basic pathways for DNA repair. Direct repair. Excision repair. Mismatch repair. Error prone repair of DNA. Other mechanisms of DNA repair. DNA modification.

Suggested readings:

1. The Cell: A Molecular Approach (2015) 7th ed., Cooper GM and Hausman RE, Sinauer Associates Inc, ISBN: 978-1605352909.
2. Molecular Biology of the Cell (2014) 6th ed., Alberts B, Johnson AD, Lewis J, Morgan D, Raff M and Roberts K, WW Norton & Company, ISBN: 978-0815344643.
3. Molecular Cell Biology (2016) 8th ed., Lodish H, Berk A, Kaiser CA, Krieger M and Bretscher A, WH Freeman and Company, ISBN: 978-1464183393.
4. Lewin's Genes XII (2017) 12th ed., Krebs JE, Goldstein ES and Kilpatrick ST, Jones and Bartlett Publishers, ISBN: 978-1284104493.
5. Molecular Biology of the Gene (2017) 7th ed., Watson JD, Tania B, Stephen PB, Alexander G, Michael L and Richard L, Pearson Education, ISBN: 978-9332585478.
6. Molecular Biology (2011) 5th ed., Weaver RF, McGraw Hill, ISBN: 978-0073525327.

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SEMESTER-II

Course title: Enzymology

Course code: SIAL BC 1 2 02 C 4004

Credit: 4

Lectures: 60

Course objective: To provide a deeper insight into the fundamentals of enzyme structure and function and kinetics of soluble and immobilized enzymes.

Learning outcomes: Upon successful completion of this course, students should be able to:

- Understanding how enzymes are able to increase speed of a biochemical reaction in sense of thermodynamics, kinetics and molecular interactions
- Interpreting and explaining significant mechanisms of regulation of enzymatic action
- Analyzing options for applying enzymes and their inhibitors in medicine and various industries

Unit-I

Introduction, general characteristics of enzymes, nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme, metal-activated and metallo-enzymes, isozymes; ribozymes. Classification and nomenclature of enzymes. Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory, reaction rates and thermodynamics of reaction, Arrhenius plot, determination of activation energy. Effect of pH, temperature and metal ions on the activity of enzyme. Fundamentals of enzyme assay – enzyme units, proximity, orientation effect. Strain & distortion theory. Catalytic power and specificity of enzymes (concept of active site), Fischer's lock and key hypothesis, Koshland's induced fit hypothesis.

Unit-II

Relationship between initial velocity and substrate concentration, derivation of Michaelis-Menten equation for uni-substrate reactions, Briggs and Haldane theory (rapid equilibrium and steady state theory), Significance of K_m , V_{max} , K_{cat} , K_{cat}/K_m . Different plots (LineweaverBurk plot, Eadie-Hofstee and Hanes plot) for the determination of K_m & V_{max} and their physiological significances. Reversible inhibition (competitive, uncompetitive, non-competitive, mixed and substrate). Mechanism based inhibitors - antibiotics as inhibitors, suicide inhibitor, transition state analogues.

Unit-III

Chemical nature of enzyme catalysis-General acid-base catalysis, electrostatic catalysis, covalent catalysis. General mechanisms of enzyme regulation, Control of activities of single enzymes (end product inhibition) reversible (glutamine synthase & phosphorylase) and Irreversible (proteases), covalent modifications of enzymes. Feedback inhibition and feed forward stimulation, Allosteric enzymes, binding of ligands to proteins, co-operativity, Hill equation. sigmoidal kinetics: MWC and KNF models. Significance of sigmoidal behavior. Study of ATCase as typical allosteric enzyme. Multienzyme complex as regulatory enzymes, mechanism of action and regulation of pyruvate dehydrogenase.

Unit-IV

Classification of multi substrate reactions with examples of each class. Kinetics of bi-substrate reactions: sequential mechanism, compulsory order and random order mechanism, ping-pong mechanism. Application of enzymes in diagnostics (SGPT, SGOT, Creatine kinase, alkaline and acid phosphatases), enzyme therapy (Streptokinase), immobilized enzymes.

Suggested readings:

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (2007) 2nd ed., Palmer T, and Bonner PL, Woodhead Publishing, ISBN: 978-1904275275.
2. Fundamentals of Enzyme Kinetics (2017) 3rd ed., Bowden AC, Medtech, ISBN: 978-9385998508.
3. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson DL and Cox MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
4. Essentials of Enzymology (2016) 1st ed., Herald J, Syrawood Publishing House, ISBN: 978-16182862285.
5. Biochemistry (2015) 8th ed., Berg JM, Stryer L and Tymoczko JL, WH Freeman and Company (New York), ISBN: 9781464126109.


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SEMESTER-II

Course title: Intermediary Metabolism
Course code: SIAL BC 1 2 03 C 4004

Credit: 4
Lectures: 60

Course objective: To help students navigate the discipline of biochemistry that explains how the collection of inanimate molecules that constitute the living systems interact, to maintain and perpetuate life.

Learning outcomes:

- Understanding the structures and functions of biological molecules
- Understanding of intermediary metabolism and its control

Unit-I

Basic design of metabolism, metabolic pathways, catabolism, anabolism, ATP as energy currency. Glycolysis - a universal pathway, reactions of Glycolysis, Fermentation, Regulation of glycolysis, fates of pyruvate, feeder pathways for glycolysis. Production of acetyl CoA. Reactions of citric acid cycle, Regulation of citric acid cycle, anaplerotic reactions, amphibolic role glyoxalate pathway, synthesis of glucose from non-carbohydrate sources, pentose phosphate pathway and its importance. Regulation of glycogen metabolism, glycogen storage diseases.

Unit-II

Oxidative phosphorylation, electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Proton motive force. Fo F1ATP synthase, structure and mechanism of ATP synthesis. Regulation of oxidative phosphorylation. Integration of metabolic pathways (carbohydrate, lipid and amino acid metabolic pathways), tissue specific metabolism (brain, muscle, and liver).

Unit-III

Digestion, mobilisation and transport of cholesterol and triacylglycerols, fatty acid transport to mitochondria, β oxidation of saturated, unsaturated, odd and even numbered and branched chain fatty acids, regulation of fatty acid oxidation, ketone bodies metabolism, ketoacidosis. Fatty acid synthase complex. Synthesis of saturated, unsaturated, odd and even chain fatty acids and regulation. Biosynthesis of steroids and isoprenoids, Integration of metabolism. Synthesis of prostaglandins, Leukotrienes and Thromboxanes and their clinical applications, cholesterol, regulation of cholesterol synthesis.

Unit-IV

Glucogenic and ketogenic amino acids. Metabolism of one carbon units, metabolic fates of amino groups. Digestion and absorption of dietary proteins. Protein calorie malnutrition. transamination, role of pyridoxal phosphate, glucose-alanine cycle, Krebs's bicycle, urea cycle and inherited defects of urea cycle. Catabolic pathways of individual amino acids. Disorders of amino acids metabolism, overview of amino acid synthesis. Biosynthesis of non-essential amino acids and its regulation. De novo synthesis of purine and pyrimidine nucleotides, regulation and salvage pathways. Digestion of nucleic acids, degradation of purine and pyrimidine nucleotides. Inhibitors of nucleotide metabolism. Disorders of purine and pyrimidine metabolism

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Suggested readings:

1. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson DL and Cox MM, WH Freeman and Company (New York), ISBN: 978-1319108243.
2. Voet's Principles of Biochemistry (2018) Global ed., Voet D, Voet JG and Pratt CW, John Wiley and Sons, ISBN: 978-1119451662.
3. Biochemistry (2015) 8th ed., Berg JM, Stryer L and Tymoczko JL, WH Freeman and Company (New York), ISBN: 9781464126109
4. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin TM, John Wiley & Sons, Inc, ISBN 13: 978-0470281734.
5. Harper's Illustrated Biochemistry (2018) 7th ed., Rodwell VW, Bender DA, Botham KM, Kennelly PJ and Weil PA, McGraw-Hill, ISBN 13: 978-1259837937.

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SEMESTER-II

Course title: Practical-II

Course code: SIAL BC 1 2 04 C 00105


Credit: 5

Lectures: 150

1. Quantitative test for determination of protein in plants/animals
2. Quantitative test for determination of carbohydrates in plants/animals
3. Separation of amino acids/ sugars by thin layer chromatography
4. Ammonium sulphate fractionation of plants/animals protein
5. Column chromatography for purification of plants/animals protein
6. Enzymatic assay of partially purified plants/animals protein
7. Determination of K_m and V_{max} using Lineweaver-Burk graph
8. Enzyme linked immune-sorbent assay (ELISA)
9. SDS-PAGE analysis of proteins. Visualization of protein bands by Coomassie and Silver staining.
10. Western blot analysis of the proteins using antibodies (immunoblotting), development by DAB/ECL

Suggested readings:

1. An Introduction to Practical Biochemistry (2017) 3rd ed., Plummer D, Tata McGraw Hill Education ISBN: 978-0070994874.
2. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed., Hoffmann A and Clokie S, Cambridge University Press, ISBN: 978-1108716987.
3. Physical Biochemistry: Principles and Applications (2016) 2nd ed., Sheehan, D, Wiley India, ISBN: 978-8126564842.
4. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1983) 2nd ed., Freifelder D, WH Freeman and Company (New York), ISBN: 978-0716714446.
5. Biophysical Chemistry: Principles and Techniques (2016) 4th ed., Upadhyay A Upadhyay K and Nath N, Himalaya Publishing House, ISBN: 978-9351422273


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SEMESTER-II

Course title: Research Methodology and Scientific Communication Skills **Credit: 2**
Course code: SIAL SC 1 2 10 DCEC 2002 **Lectures: 30**

Course objective: To provide knowledge about tools and techniques related with scientific communication and research methodology.

Learning outcomes:

- Understanding the existence of scientific knowledge in ancient times
- Acquiring the skills of scientific reading, writing and presentations
- Appreciating the scientific ethics through case studies

Unit-I

Empirical science; scientific method; manipulative experiments and controls; deductive and inductive reasoning; descriptive science; reductionist vs holistic biology.

Unit-II

Choosing a mentor, lab and research question; maintaining a lab notebook. Concept of effective communication- setting clear goals for communication; determining outcomes and results; initiating communication; avoiding breakdowns while communicating; creating value in conversation; barriers to effective communication; non-verbal communication-interpreting non-verbal cues; importance of body language, power of effective listening; recognizing cultural differences.

Unit-III

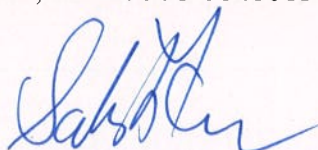
Presentation skills - formal presentation skills; preparing and presenting using over-head projector, PowerPoint; defending interrogation; scientific poster preparation & presentation; participating in group discussions; Computing skills for scientific research - web browsing for information search; search engines and their mechanism of searching; hidden Web and its importance in scientific research; internet as a medium of interaction between scientists; effective email strategy using the right tone and conciseness.

Unit-IV

Technical writing skills - types of reports; layout of a formal report; scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts; publishing scientific papers - peer review process and problems, recent developments such as open access and non-blind review; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.

Suggested readings:

1. Research Methodology: Methods And Techniques (2019) 4th ed., Kothari CR and Garg G, New Age International Publishers, ISBN: 978-9386649225.
2. Communicate Science Papers, Presentations, and Posters Effectively (2015) Patience GS, Boffito DC, Patience P, Academic Press, ISBN: 978-0128015001.



3. Successful Scientific Writing: A Step-by-Step Guide for the Biological and Medical Sciences (2014) 4th ed., Matthews JR and Matthews RW, Cambridge University Press ISBN: 978-1107691933.
4. Doing Science: Design, Analysis, and Communication of Scientific Research. (2001) Valiela I, Oxford: Oxford University Press, ISBN 10:019538573X.
5. On Being a Scientist: a Guide to Responsible Conduct in Research. (2009) 3rd ed., Washington DC, National Academies Press.

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SEMESTER-II

Course title: Bio-entrepreneurship
Course code: SIAL SC 1 2 11 DCEC 2002

Credit: 2
Lectures: 30

Course objectives: To teach students about concepts of entrepreneurship including identifying a winning business opportunity, gathering funding and launching a business, growing and nurturing the organization and harvesting the rewards.

Learning Outcomes:

- Gain entrepreneurial skills and understand the various operations involved in venture creation
- Identifying scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centres and various agencies

Unit-I

Introduction and scope in Bio-entrepreneurship, Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech), Strategy and operations of bio-sector firms: Factors shaping opportunities. For innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities, Alternatives faced by emerging bio-firms and the relevant tools for strategic decision, Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies.

Unit-II

Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills.

Unit-III

Business plan preparation including statutory and legal requirements, Business feasibility study, financial management issues of procurement of capital and management of costs, Collaborations & partnership, Information technology.

Unit-IV

Technology – assessment, development & upgradation, Managing technology transfer, Quality control & transfer of foreign technologies, Knowledge centers and Technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GCP, GLA, GMP).

Suggested readings:

1. Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge, Routledge Studies in Innovation, Organizations and Technology (2018) 1st ed. Onetti, A, & Zucchella, A, CRC press, Taylor and Francis group. ISBN: 9781138616905.
2. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Shimasaki, CD (2014) Amsterdam: Elsevier. Academic Press is an imprint of Elsevier, ISBN: 0124047300.

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3. Innovation, Commercialization, and Start-Ups in Life Sciences. (2014) 1st ed. Jordan, JF, CRC Press. Taylor and Francis group, ISBN: 9781482210125.
4. The Dynamics of Entrepreneurial Development and Management. (2011) 6th ed., Desai V, New Delhi: Himalaya Pub. House, ISBN: 9350244543.
5. Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences (2008) Adams, DJ, Sparrow JC, Bloxham, Scion, ISBN:1904842364.

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SEMESTER-II

Course title: Cell and Tissue Engineering
Course code: SIAL BC 1 2 01 DCEC 4004

Credit: 4
Lectures: 60

Course objective: To design, optimize and maintain biomedical systems in tune with community needs and environmental concerns.

Learning outcomes:

- Designing a system to meet desired needs within realistic constraints
- Understanding professional and ethical responsibilities as well as regulatory issues

Unit-I

Definition of biomaterials, requirements of biomaterials, classification of biomaterials, properties of common biomaterials, Physical and mechanical properties of biomaterials, Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk, hydrogels and polylactic acid), 3-D architecture/printing and cell incorporation, Biocompatibility, basic transplant immunology.

Unit-II

Fundamental of tissue engineering, Structural and organization of tissues: Epithelial, Endothelial, Mesenchymal, Connective. Basic wound healing, cell migration, in-vitro testing.

Unit-III

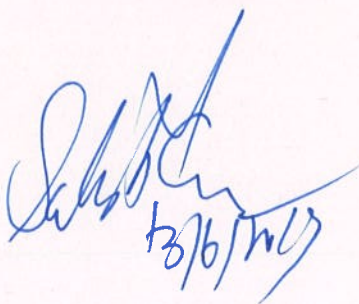
Types of cells for tissue engineering, progenitor cells and cell differentiations, cell matrix and cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, genetic engineering of cell, cell storage and cell characterization, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and tissue specific cell surface markers.

Unit-IV

Tissue engineering of Bone, Cartilage, Blood vessels, Heart, Cell transplantation, Ethical, social and regulatory issues with tissue engineering.

Suggested readings:

1. Principles of Tissue Engineering (2013) 4th ed., Lanza, RP, Langer, R and Vacanti, JP, Academic Press, ISBN: 978-0123983589.
2. Biomaterials (Bioengineering and Health Science (2014) 1st ed., Migonney, V, ISTE Ltd., ISBN: 978-1848215856.
3. Nanomedicine and Tissue Engineering: State of the Art and Recent Trends (2016) 1st ed., Kalarikkal, N, Augustine, R, Oluwafemi, OS, Joshy, KS and Thomas, S, Apple Academic Press. ISBN: 978-1771881180.
4. Tissue Engineering (2018) 2nd ed., Blitterswijk, CV and Boer, JD, Academic Press ISBN: 978-0128100288.
5. Biomaterials: A Basic Introduction (2018) 1st ed., Chen, Q and Thouas, G, CRC Press, ISBN: 978-1138749665.



SEMESTER-II

Course title: Neurobiochemistry
Course code: SIAL BC 1 2 02 DCEC 4004

Credit: 4
Lectures: 60

Course objective: The course aims to provide an advanced understanding of the core principles and topics of Neurobiochemistry and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a stem/branch lecture series and a research project.

Learning outcomes:

- Actively discussing contemporary issues in neuroscience with critical thinking and methods generation in mind.
- Developing methods to test a research question in neuroscience.

Unit-I

Central nervous system – general features of neuron. Cellular organization of neuron, dendrites and axons, neurotubules, neurofilaments, synapse neuralgia, astrocytes, oligodendrocytes, ependymal cells, Schwann cells. Muscle, nerve ending, sensory receptors and effectors endings, peripheral nerves, spinal and cranial nerves, plexuses ganglia, afferent pathways and sense organs

Unit-II

Topographical anatomy, spinal nerves, spinal meninges, joint reflexes, gray and white matter of spinal cord. Cellular organization of specific regions such as cerebellum, cerebral cortex, hippocampus, retina, evolution of nervous system – a comparative aspect. Neuronal membrane, excitability, ion channels and transport of ions.

Unit-III

Structure function correlation at the synapse. Transmission across the synapse: membrane potential in the steady state, action potential generation and propagation. Cholinergic and non-cholinergic synapses. Postsynaptic Events at the Neuromuscular Junction. Formation, structure and biochemistry of myelin, chemistry of major brain lipid, developmental changes, lipid composition, biosynthesis and catabolism of major lipid, characteristics of brain lipid, regional variations.

Unit-IV

Neurotransmitter: chemistry, synthesis, storage and release of nervous neurotransmitters, transmitter action, synaptic modulation and mechanism of neuronal integration. Energy metabolism: normal oxygen consumption by the brain, energy demanding function, role of cerebral circulation, local cerebral blood flow and metabolism, effects of glucose deprivation.

Suggested Readings:

1. Basic Neurochemistry: Principles of Molecular, Cellular, and Medical Neurobiology (2011) 8th ed., Brady S, Siegel G, Albers RW and Price D, Academic Press, ISBN: 978-0123749475.
2. Guyton & Hall Textbook of Medical Physiology (2016) 2nd ed., Vaz M, Raj T and Anura K Elsevier India, ISBN: 978-8131244661.
3. Molecular Biology of the Cell (2014) 6th ed., Alberts B, Johnson AD, Lewis J, Morgan D, Raff M and Roberts K, W. W. Norton & Company, ISBN: 978-0815344643.N

4. Neuroprogression in Psychiatry (2019) 1st ed., Kapczinski F, Magalhaes PVS and Berk M, Oxford University Press, ISBN: 978-0198787143.
5. Advances in Neurochemistry (2012), 1st ed., Agranoff BW and Aprison, MH, Springer, ISBN: 978-1468475432.

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SEMESTER-III

Course title: Biostatistics and Bioinformatics

Course code: SIAL SC 1 3 12 C 4004

Credit: 4

Lectures: 60

Course objective: The course is aimed at introducing the students to the field of Bioinformatics and enable them to understand the concepts of statistics in biology.

Learning outcomes:

- Understanding statistical analysis of biological data
- Understanding the role of computer science in predicting structure and function of biomolecules
- Understanding similarities and differences among living organisms on the basis of genetic information

Unit-I

Definition of selected terms scale of measurements related to statistics; Methods of collecting data, Presentation of data statistical Tables, Need for reduction of data measures of averages and location, Measures of dispersion: Range, quartile deviation, mean deviation and relative deviation.

Unit-II

Probability: basic concepts; basic theorems of probability addition and multiplication theorems; Conditional probability of Bayes Theorems. Probability mass function, probability density function, cumulative distribution function. Probability distribution definition and applications; Binominal distribution, Poisson distribution, Normal distribution, Logic of statistical standard error estimation testing of hypothesis.

Tests of significance: Null hypothesis, alternative hypothesis, type I error, type II error, level of significance, and power of test. Tests for mean based on normal distribution, one sample t-test, two-sample t-test, paired-sample t-test, Chi-Squared test, and Tests for variance based on normal distribution – one sample and two-sample problem. One-way and Two-way analysis of variance (ANOVA) techniques. Correlation concept and applications, Spearman's rank correlation coefficient, regression concept and applications.

Unit-III

Historical background. Scope of bioinformatics - genomics, proteomics, computer aided drug design (structure based and ligand based approaches), Applications of bioinformatics. Introduction to biological databases - primary, secondary and composite databases, Different formats of molecular biology data. NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB)

Exercises

- Sequence retrieval (protein and gene) from NCBI.
- Structure download (protein and DNA) from PDB.
- Molecular file formats - FASTA, GenBank,

Unit-IV

Similarity, identity and homology. Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTAL omega. Identification of open reading frames (ORF)

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Concept of orthology, paralogy and homology in gene and protein sequences. Methods and tools for phylogenetic analysis- trees - maximum parsimony, maximum likelihood and distance methods; Creation, evaluation and interpretation of evolutionary trees phylogenetic tree.

Exercises

- BLAST suite of tools for pairwise alignment.
- Multiple sequence alignment using CLUSTAL omega
- Generating phylogenetic tree using PHYLIP.
- Primary sequence analyses (Protparam)

Suggested Readings:

1. Fundamentals of Statistics (2016) Goon, AM, Gupta, MK and Dasgupta, B. Vol. I & II. World Press, ASIN: B01LB7MH74.
2. Statistical Methods (2012) 1st ed., Das, NG. Vol I & II. Tata McGraw Hill, ISBN: 9780070263512.
3. Probability and Statistics for Engineers and Scientists (2013) 9th ed., Walpole, RE, Myers, RH, Myers, SL and Ye, Pearson Education India KE ISBN: 978-9332519084
4. Biostatistics: A Foundation. for Analysis in the Health Sciences (2012) 10th ed., Daniel, WW and Cross, CL. John Wiley & Sons, ISBN: 978-1118302798
5. Essential Bioinformatics (2006) 1st ed., Xiong J, Cambridge University Press, ISBN 13: 978-0521600828.
6. Fundamental concepts of Bioinformatics (2003) Krane DE and Raymer ML Pearson, ISBN: 978-8177587579.
7. An Introduction to Bioinformatics (2017) 1st ed., Knight R, Larsen and Keller Education, ISBN: 978-1635490459.
8. Concepts of Bioinformatics and Genomics (2016) 1st ed., Momand J, McCardy A, Heubah, S and Warter-Perez N, Oxford University Press, ISBN: 978-0199936991

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SEMESTER-III

Course title: Biophysics and Nanosciences
Course code: SIAL SC 1 3 13 C 4004

Credit: 4
Lectures: 60

Course objectives: To explore the complexity of living systems with a quantitative physical approach, fundamentals of nanoscale structured materials and also discuss various biomedical & agricultural applications of different nanomaterials.

Learning outcomes:

- Understanding the core concepts of biology, chemistry and physics and how they interconnect in biophysical systems
- Expansion of knowledge of standard molecular and biophysical techniques to design experiments in a specific research area
- Understanding fundamental principles of nanotechnology also discuss state-of-the-art synthesis of different nanomaterials
- Elucidating the emerging need of nanotechnology in environment, health; and safety, and incorporate them into basic education that can be immediately employed in industry

Unit-I

Introduction to Biophysics and history of Biophysics, main features of quantum theory, Elementary particles and their interactions, mechanism of molecular energy transfer, Distribution of molecular energy and velocity at equilibrium, Energy of activation, Different types of forces and stereo-chemical factors responsible for molecular conformation, Defining conformation of a macromolecular chain, complex array of biomolecular structures found in DNA and proteins due to interactions. Main methods of studying the structure of proteins and DNA, protein folding pathways, Levinthal's paradox, Molten globule, Anfinsen's experiment, Methods for investigating folding: Fluorescence spectroscopy, Circular dichroism. Macromolecular interactions, Biophysical methods of interactions: Microcalorimetry (Isothermal Titration Calorimetry (ITC), Surface Plasmon Resonance (SPR).

Unit-II

Basic concepts and laws of thermodynamics, Gibbs free energy, Enthalpy and Entropy, Energetic processes in living organism, Information and Entropy, Coupling of fluxes, Coupling of Chemical Reactions, Redox potential in biological system, ATP production. Introduction to membrane Biophysics, fundamental role of biomembranes, interfacial phenomena and membranes, surface and interfacial tensions, self-assembly of membranes, molecular structure of membranes, Structure & function of membranes, Nernst equation (based on membrane permeable for a single kind of ions), Resting membrane potential, Action potential, Biophysics of synapse, patch clamping/voltage clamp and their applications to the study of biomacromolecules.

Unit-III

Overview of nanotechnology - historical perspective of integration of biology, chemistry, and material science. Opportunities and promises of nanobiotechnology. Top down and bottom up approaches of synthesis of nanoparticles, synthesis of nanoparticles by physical, chemical and biological methods; nucleation and growth of nanosystems, factors affecting synthesis of nanoparticles, Debye-Scherrer method, particle size determination using UV absorption spectra peaks and photoluminescence peaks, dynamic light scattering (DLS), SEM. Nanomaterials used in biotechnology-nanoparticles, carbon nanotubes, quantum dots and nanofibres.

Unit-IV

Miniaturized Devices-nanotechnology and biomedical devices: Overview of smart devices for medical field, lab on chip concept, epipen, intelligent pill, wobbling gels.

Nanotechnology and diagnostics and therapy-Nano-Biosensing-biosensors and nanobiosensors -basics, DNA aptamers for nano-biosensing. Use of nanotechnology in diagnosis of chronic diseases like diabetes and coronary heart diseases; parasitic disease like malaria.

Nanotechnology in agriculture, food technology & environment: Insecticides development using nanotechnology and Nanofertilizers, nanotechnology in food processing, safety & smart packaging, applications of nanotechnology in water purification and oil spill removal.

Suggested readings:

1. An introduction to Biophysics (2018), 1st ed., Burns, D, Forgotten Books, ISBN: 978-1330860212.
2. Biophysics - An Introduction (2014) 1st ed., Cotterill, R, Wiley, ISBN: 978-8126551606.
3. Biophysics: An Introduction (2012) 2nd ed., Glazer, Springer, ISBN: 978-3642252112.
4. Nanobiotechnology: Concepts, Applications and Perspectives (2012) 1st ed., Niemeyer, CM and Mirkin, CA, Wiley India Pvt Ltd., ISBN 13: 978-8126538409.
5. A Textbook of Nanoscience and Nanotechnology (2017) 1st ed., Pradeep T, McGraw Hill Education, ISBN: 978-1259007323.

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SEMESTER-III

Course title: Plant Biochemistry

Course code: SIAL BC 1 3 05 C 4004

Credit: 4

Lectures: 60

Course objective: The course is intended for students in the plant sciences. Successful completion of this course will provide students with fundamental knowledge of biochemistry and specific knowledge of compounds and biochemical pathways that occur in plants.

Learning outcomes:

- Understanding plant cell structure, organization, and apply specific biochemical functions to all compartments of the plant cell
- Learning the structure, function and biosynthetic pathways of essential biochemical molecules including their key chemical and physical properties

Unit-I

Introduction to plant cell structure, fluid mosaic model, photosynthesis and carbon assimilation plasma membrane, vacuole and tonoplast membrane, cell wall, plastids and peroxisomes. Structure of PSI and PSII complexes, Light reaction, Cyclic and non-cyclic photophosphorylation, Calvin cycle and regulation; C4 cycle and crassulacean acid metabolism (CAM), photorespiration.

Unit-II

Nitrogen metabolism, biological nitrogen fixation by free living and in symbiotic association, structure and function of enzyme nitrogenase. nitrate assimilation: nitrate and nitrite reductase. Primary and secondary ammonia assimilation in plants; ammonia assimilation by glutamine synthetase-glutamine oxoglutarate amino transferase (GS-GOGAT) pathway. Seed storage proteins in legumes and cereals.

Unit-III

Secondary metabolites, representatives alkaloid group and their amino acid precursors, function of alkaloids, Examples of major phenolic groups; simple phenylpropanoids, coumarins, benzoic acid derivatives, flavonoids, tannins and lignin, biological role of plant phenolics, classification of terpenoids and representative examples from each class, biological functions of terpenoids.

Unit-IV

Regulation of plant growth, Introduction to plant hormones and their effect on plant growth and development, Regulation of plant morphogenetic processes by light. Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, cell suspension culture and protoplast culture. Plant regeneration pathways: organogenesis and somatic embryogenesis. Applications of cell and tissue culture and somoclonal variation.

Suggested readings:

1. Plant Biochemistry: Concepts and Applications (2018), Granger TC, ISBN: 9781632399878.
2. Biochemistry and Molecular Biology of Plant (2015) 2nd ed., Buchanan BB, Gruissem W and Russel LJ, Wiley-Blackwell. ISBN: 978-0470714218.
3. Plant Biochemistry (2013) 3rd ed., Walter HH, cbspd, ISBN-13: 978-8131200032.

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4. Outlines of Biochemistry (2006) 5th ed., Conn EE, Stumpf PK, Bruening G and Roy HD, Wiley, ISBN: 978-8126509300.
5. Fundamentals of Plant Physiology (2018) 6th ed., Taiz L, Zeiger E, Møller IM and Murphy A, Sinauer Associates Inc, ISBN: 978-1605357904.

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SEMESTER-III

Course title: Clinical Biochemistry and Molecular Diagnostics
Course code: SIAL BC 1 3 06 C 4004

Credit: 4
Lectures: 60

Course objective: This course provides a comprehensive overview of the fundamental principles of clinical and molecular diagnostics and explores the use of molecular techniques in the diagnosis of disease.

Learning outcomes:

- Gaining a solid foundation in the most commonly utilized molecular diagnostic testing protocols
- Applying the knowledge of molecular testing to the most commonly performed applications in the clinical laboratory
- Interpreting the correct execution and interpretation of a molecular test

Unit-I

Clinical Biochemistry - concept, definition and scope; Biological samples - types, collection, processing, stability and storage; Phlebotomy; serum and serum separator devices; chemical composition of biological fluids - blood, urine and cerebrospinal fluid; Reference range; quality assurance; accuracy and precision; factors influencing the accuracy of results; Levy-Jennings's chart; Reliability of a laboratory method; interferents; responsibilities of a clinical biochemist.

Unit-II

Biochemical tests in clinical practice – characteristics and uses of a biochemical test; criteria for selecting a method for biochemical analysis; enzymes as diagnostic tool; advantages and disadvantages of enzyme assays; Isozymes and their diagnostic importance; methods for the detection of isoenzymes; organ function tests - clinical presentation and diagnosis of the diseases of the liver and kidney; bilirubin metabolism; Acid base disorders.

Unit-III

Overview of molecular diagnostics, molecular diagnostics: past, present, and future, history & scope, definition, principle of biosensors: classification of biosensors based on transducer & recognition element. Components & basic designing of biosensors, different types of biosensors. Nanotechnology and biosensors: carbon nanotubes, gold nanoparticles. Latex agglutination test, Enzyme Linked Immunosorbent assay, dot and slot blot assay.

Unit-IV

PCR in molecular diagnostics; multiplex-PCR, quantitative real time PCR (qRT-PCR) and their applications for diagnosis of disease applications, DNA diagnostic system: molecular beacons and its variants for their applications in detection, Molecular diagnostics in bacterial detection, rolling circle amplification, application of padlock and selector probes in molecular medicine, DNA aptamers for nano-biosensing, diagnostics for point-of-care and resource limited settings, Smartphones in medical diagnostics, rapid diagnostic tests (lateral flow assays), concepts of microfluidics, BioMEMs in diagnostics.

Suggested readings:

1. Clinical Biochemistry (2018) 6th ed., Murphy M, Srivastava, R and Deans, K, Elsevier ISBN 13: 978-0702072987.

2. Tietz Fundamentals of Clinical chemistry and Molecular diagnostics. (2014) 7th ed., Burtis, CA and Bruns DE, Elsevier, ISBN: 978-8131238851.
3. Biomedical Nanotechnology (2005) 1st ed., Malsch N, CRC Press, ISBN: 978-0824725792.
4. Biosensors and Nanotechnology: Applications in Health Care Diagnostics (2018) 1st ed., Altintas Z, Wiley-Blackwell, ISBN: 978-1119065012
5. Biosensors: Essentials (2016) 1st ed., Evtugyn G, Springer, ISBN 13: 978-3662509388
6. Nucleic Acids as Molecular Diagnostics (2014) 1st ed., Keller A, Wiley VCH, ISBN: 978-3527335565.

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SEMESTER-III

Course title: Practical-III

Course code: SIAL BC 1 3 07 C 0084

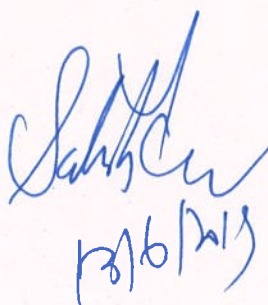
Credit: 4

Lectures: 120

1. Genomic DNA isolation from plant/bacteria/animal
2. Qualitative and quantitative analysis of DNA.
3. Preparation of culture media
4. Bacterial culture: establishing a pure culture; identification of bacteria; staining techniques; antibiotic sensitivity of bacteria
5. Isolation of plasmid DNA
6. Restriction digestion of plasmid by restriction endonucleases and separation of restriction fragments by agarose gel electrophoresis
7. Isolation of RNA and separation on agarose gel
8. Quantitative estimation of RNA
9. Polymerase chain reaction
10. Assay based on agglutination reactions- blood typing (native) and passive agglutination
11. Estimation of blood glucose.
12. Estimation of tryglycerides, bilirubin and urea in blood serum

Suggested readings:

1. An Introduction to Practical Biochemistry (2017) 3rd ed., Plummer, D, Tata McGraw Hill Education ISBN 13: 978-0070994874.
2. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th ed., Hoffmann, A and Clokie, S, Cambridge University Press, ISBN 13: 978-1108716987.
3. Physical Biochemistry: Principles and Applications (2016) 2nd ed., Sheehan, D, Wiley India, ISBN 13; 978-8126564842.
4. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1983) 2nd ed., Freifelder, D, WH Freeman and Company (New York), ISBN 13; 978-0716714446.
5. Biophysical Chemistry: Principles and Techniques (2016) 4th ed., Upadhyay, A Upadhyay, K and Nath N, Himalaya Publishing House, ISBN 13: 978-9351422273


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SEMESTER-III

Course title: Interactive group discussion cum seminar

Course code: SIAL BC 1 3 08 C 0202

Credit: 2

This course is aimed for interactive group discussion on IPR, Bioethics and Biosafety. Seminar will be of 45-minute duration during which the presentation will be followed by questions session by the audience comprising of faculty and students. Every student shall be required to submit the topic of his/her seminar in consultation with the Head of the Department/Faculty members/student advisors well in advance so that the same may be displayed on the notice board. The presenter has to write an Abstract to be distributed during Seminar in addition to two copies of write-up giving relevant details of the background of the subject, methods used and references/List of sources from where the material for presentation has been collected.

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SEMESTER-III

Course title: Nutritional Biochemistry

Course code: SIAL BC 1 3 03 DCEC 4004

Credit: 4

Lectures: 60

Course objective: The students will learn how nutrients effect biochemical processes and signal transduction pathways, and how this can lead to development of nutritionally related diseases.

Learning outcomes:

- Critically analyze and evaluate concepts in nutritional biochemistry that are important for an understanding of nutrition
- Understanding the major metabolic pathways involved in the metabolism of nutrients in the human body

Unit-I

Definition of Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. Physiological energy value of foods, SDA. Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.

Unit-II

Functions of carbohydrates. Digestion, absorption, utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, dietary fiber, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions. Classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/omega 6 ratio b) phospholipids c) cholesterol in the body d) mono, polyunsaturated and saturated Fatty Acids. Dietary implications of fats and oils, MUFA, PUFA and SFA. Functions of proteins in the body, digestion and absorption. Essential and non-essential amino acids, Toxicity and imbalance, amino acid supplementation. Effects of deficiency. Food source and recommended dietary allowances. Nitrogen balance.

Unit-III

Vitamin A, D, E, K Dietary sources, RDA, adsorption, distribution, metabolism and excretion (ADME), Deficiency. Role of Vitamin A as an antioxidant, Role of vitamin K. Role of vitamin E as an antioxidant. Extra-skeletal role of vitamin D. Hypervitaminosis. Vitamin C role as cofactor. Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms. Vitamin B12 and folate; dietary source, RDA, absorption, metabolic role, biochemical basis for deficiency symptoms.

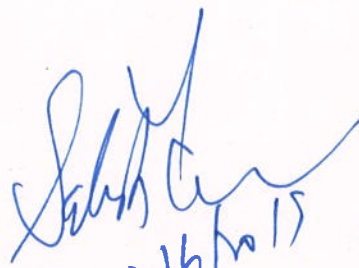

Unit-IV

Calcium, phosphorus, iodine, fluoride, Mg, Cu, Zn, Se, manganese, chromium, molybdenum and iron - distribution in the body digestion, absorption, utilization, transport, excretion, balance. anthropometric measurements. Biochemical assessment. ROS assessment, GTT and glycosylated Hb, Differential diagnosis of B12 and folate.

Suggested readings:

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin TM, John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Nutrition for Health, Fitness and Sport (2016) 11th ed., Williams MH, Anderson DE and Rawson ES, McGraw Hill Education, ISBN: 978-0078021350

3. Krause's Food and Nutrition Care Process (2016) 14th ed., Mahan LK, Strings SE and Raymond, J, Elsevier's Publications. ISBN: 978-0323340755.
4. The vitamins, Fundamental aspects in Nutrition and Health (2017) 5th ed., Coombs Jr, GF and McClung JP, Academic Press. ISBN:978-0128029657
5. Nutritional Biochemistry: Current Topics in Nutrition Research (2015) 1st ed., Cox C, Apple Academic Press, ISBN: 978-1771881456


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SEMESTER-III

Course title: Pharmaceutical Biochemistry
Course code: SIAL BC 1 3 04 DCEC 4004

Credit: 4
Lectures: 60

Course objective: To apply the basic concepts in the specific field of Pharmaceutical Industry. The student will gain insight into the working of a pharma industry, various classes of biotech products and the regulations governing production and marketing of pharmaceutical products.

Learning outcomes:

- Understanding the structural and functional properties of cells, their chemical composition and their overall metabolism with special reference to the situation in man
- Identifying the causes of disease and effects of existing drugs and development of new modes of treatment

Unit-I

Definition, introduction, importance and history, drug, medicine, difference between drug and medicine, drug discovery process, methods of drug discovery and development.

Unit-II

Physicochemical properties in relation to biological action – effects of route of administration, drug targets, validation techniques of pharmaceutical targets, pharmacokinetics and pharmacodynamics of drugs, drug toxicity.

Unit-III

Introduction to vaccines, types of vaccine, importance of vaccine, DNA vaccines, vaccines & monoclonal antibody based pharmaceuticals, antibiotics, characterization and bioanalytical aspects of recombinant proteins as pharmaceutical drugs.

Unit-IV

formulation of biotechnological products, drug delivery, examples of some biotechnological products in clinical development, food and drug administration (FDA) role of FDA, international council for harmonization (ICH), ICH guidelines, current good manufacturing practice (cGMP), importance of cGMP, the regulation of pharmaceutical biotechnological products and ethical issues.

Suggested readings:

1. An Introduction to Medicinal Chemistry (2018) International ed., Patrick G, Oxford University, ISBN: 978-0198796589
2. Pharmaceutical Biotechnology: Fundamentals and Applications (2019) 5th ed., Crommelin DJ, Sindelar RD and Meibohm B, Springer, ISBN: 978-3030007096.
3. Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications (2012) 2nd ed., Kayser O and Warzecha H, John Wiley & Sons, ISBN: 978-3527329946
4. The Indian Pharmaceutical Industry: Impact of Changes in the IPR Regime. (2018) 1st ed., Mitsumori Y, Springer, ISBN: 978-9811067907.
5. The Pharmacist Guide to Implementing Pharmaceutical Care (2018) 1st ed., da Costa, FA, van Mil JWF and Risco AA, Springer, ISBN: 978-3319925752

SEMESTER-III

Course title: Advance Molecular Biology

Course code: SIAL BC 1 3 03 GEC 4004

Credit: 4

Lectures: 60

Course objective: To acquaint students with chromatin structure and gene expression, post-transcriptional events and translation.

Learning outcomes:

- Understanding the basic concepts of transcription and translation in prokaryotes and eukaryotes
- Understanding the mechanism of gene expression in prokaryotes and eukaryotes

Unit-I

DNA as genetic material; primary, secondary and three-dimensional structures of DNA; super coiling; forms of DNA; polytene and lamp brush chromosomes; properties of DNA in solution; denaturation and renaturation; reassociation reactions; COT curves; types of RNAs and their primary and secondary structure; role of RNA; unusual bases in RNA.

Unit-II

Replication of DNA and synthesis of RNA; central dogma of molecular biology; DNA and RNA polymerases and other enzymes involved in replication; mechanisms of replication; inhibitors of transcription; proof reading function and fidelity of DNA replication; possible modes of DNA replication; theta model and rolling circle model of DNA replication; replication of DNA in eukaryotes; role of methylation; replication of viral RNA; reverse transcriptase. Prokaryotic and eukaryotic gene structure; transposable elements in bacteria; mobile elements in eukaryotes; regulatory region and transcriptional unit of gene; post transcriptional processing of RNA: splicing, cap addition and polyadenylation polynucleotide phosphorylase; classification and molecular basis of mutation; Ames test and other testing systems; repair mechanism in prokaryotes and eukaryotes; site directed mutagenesis.

Unit-III

Translation; adapter role of RNA in protein synthesis; size of the code; methods of deciphering the genetic code; code word dictionary; general features of the genetic code; identification of anticodons ; wobble hypothesis; ribosome as the site of protein synthesis; polysomes ; activation of amino acids; initiation, elongation and termination of protein synthesis in prokaryotes and eukaryotes. Control of translation: role of guanine nucleotides; post-translational processing of the polypeptide chains; acetylation, methylation, phosphorylation by protein kinases; sulfation; glycosylation.

Unit-IV

Gene expression in prokaryotes; enzyme induction and repression; negative and positive control; concept of operon; catabolite repression; transcriptional termination control via mRNA alternative conformations; regulation of gene expression in eukaryotes; promoters ,enhancers and response elements; regulation at transcriptional level: Britten Davidson Model; control by steroid hormones. Role of chromatin structure in gene expression; cytoplasmic regulation of gene expression; organelle genome; epigenetics.

Suggested readings:

1. Lewin's Genes XII (2017) 12th ed., Krebs, JE, Goldstein, ES and Kilpatrick, ST, Jones and Bartlett Publishers, ISBN 13: 978-1284104493.

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2. Molecular Biology of the Gene (2017) 7th ed., Watson, JD, Tania, B, Stephen PB, Alexander, G, Michael, L and Richard, L, Pearson Education, ISBN13: 978-9332585478.
3. Molecular Biology (2011) 5th ed., Weaver, RF, McGraw Hill, ISBN 13; 978-0073525327
4. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, DL and Cox, MM, WH Freeman and Company (New York), ISBN 13: 978-1319108243.
5. Biochemistry (2017) 6th ed., Garrett, RH and Grisham, CM, Brooks/Cole, ISBN: 9781305577206.

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SEMESTER-III

Course title: Stem Cell Biology

Credit: 4

Course code: SIAL BC 1 3 04 GEC 4004

Lectures: 60

Course objective: The course will provide students with knowledge of wide-ranging topics related to stem cell and regenerative biology, including: a brief history of the field, research on animal models of regeneration, tissue engineering, and the political and ethical issues surrounding the stem cell debate.

Learning outcomes:

- Understanding how stem cells are derived for scientific research
- Compare and contrast tissue-specific stem cell types, and the basic mechanisms that regulate them

Unit-I

Introduction to Stem cell biology - What are stem cells (Properties, Existence), applications and current understanding of the stem cell technology.

Unit-II

Stem Cells in detail: embryonic stem cells, stem cells from adults. Pluripotency necessary, or is unipotency enough? What are the mechanisms? Stem-cell plasticity, regulators of pluripotency and differentiation of stem cell. The isolation, expansion, genetic manipulation, genomic reprogramming, and cloning of stem cells. The problem of differentiation of stem cells. Stem cells and imprinted genes. Differences between adult and embryonic stem cells, what types of cells adult stem cells can become.

Unit-III

Regenerative medicine: current stem cell therapies, How we can use stem cells for studying cancer and finding cures to other diseases, correlation between stem cells and cancer, stem cells and aging. Clinical applications of hematopoietic stem cells from cord blood first successful transplantation of cord blood in a child with Fanconi's anemia. Treatment of neural diseases such as Parkinson's disease, Huntington's disease and Alzheimer's disease. Repair of damaged organs such as the liver and pancreas.

Unit-IV

culture and differentiation of human pluripotent stem cells, classroom and laboratory experience in the techniques for deriving, culturing and differentiating human pluripotent stem cells (hPSCs) and related cell types.

Suggested readings:

1. Trends in stem cell biology and Technology (2009) Baharvand H, Humana Press, ISBN: 978-1603279048.
2. Essentials of Stem Cell biology (2013) 3rd ed., Lanza RP and Anthony A, Elsevier Academic Press, ISBN: 978-0124095038.
3. Stem Cell Therapy: A Rising Tide: How Stem Cells Are Disrupting Medicine and Transforming Lives (2017) Riordan NH, ISBN: 978-0999045305.
4. The Stem Cell Revolution (2015) Lander E and Berman MD, Author House, ISBN: 978-1504920018.
5. The Cell Biology of Stem Cells (2010) Eran M and Kathrin P, Springer, ISBN: 978-1441970374.

SEMESTER-IV

Course title: Dissertation

Credit: 20

Course code: SIAL BT 1 4 01 SEEC 0020

Guidelines for Project File

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The file is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated goals.
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen that may be useful to document for future reference.
- The guidelines and format for dissertation is given below:

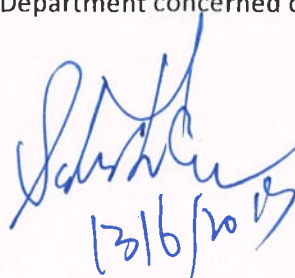
Dissertation Guidelines

1. GENERAL :

The manual is intended to provide broad guidelines to the M.Sc. candidates in the preparation of the dissertation report. In general, the project report shall report, in an organised and scholarly fashion an account of original research work of the candidate leading to the discovery of new facts or techniques or correlation of facts already known.

2. NUMBER OF COPIES TO BE SUBMITTED:

Students should submit three copies to the Head of the Department concerned on or before the specified date.


13/6/2013



3. ARRANGEMENT OF CONTENTS OF DISSERTATION:

Dissertation material should be arranged as follows:

1. Cover Page & Title page
2. Declaration
3. Certificate
4. Abstract (Hindi and English)
5. Acknowledgements
6. Table of Contents
7. List of Tables
8. List of Figures
9. List of Symbols, Abbreviations and Nomenclature (Optional)
10. Chapters
11. References
12. Appendices
13. One page CV

The Tables and Figures shall be introduced in the appropriate places.

4. PAGE DIMENSIONS AND MARGIN:

The dimensions of the dissertations should be standard A4 size paper may be used for preparing the copies, **standard margin** with 1.5 line spacing.

5. MANUSCRIPT PREPARATION:

The general text of thesis shall be typed in font style Times New Roman and font size 12. Same quality of paper should be used for the preparation of the entire report/thesis; except figure, photos are shown.

5.1 Cover Page & Title Page - A specimen copy of the Cover page & Title page for report/thesis are given in Annexure I.

5.2 Certificate-The Bonafide Certificate as per the format shown in Annexure II

5.3 Abstract: Abstract should be an essay type (HINDI and ENGLISH) of narration not exceeding 500 words outlining the research problem, the methodology used for tackling it and a summary of the findings, typed in 1.5 line spacing.

5.4 Acknowledgements: The acknowledgements shall be brief and should not exceed one page. The student's signature shall be made at the right bottom above his / her name typed in capitals.

5.5 Table of contents - The table of contents should list all material following it as well as any material which precedes it. The title page, Bonafide Certificate and Acknowledgment will not find a place among the items listed in the Table of Contents but the page numbers in lower case Roman letters are to be accounted for them. One and a half spacing should be adopted for typing the matter under this head. A specimen copy of the Table of Contents for report / thesis is given in Annexure III.

5.6 List of Table - The list should use exactly the same captions as they appear above the tables in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head.

5.7 List of Figures - The list should use exactly the same captions as they appear below the figures in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head

Signature
(13) 6/10/15

5.8 List of Symbols, Abbreviations and Nomenclature - One and a half spacing should be adopted for typing the matter under this head. Standard symbols, abbreviations etc. should be used.

5.9 Chapters - The chapters may include

Chapter I – Introduction

Chapter II - Literature Review

Chapter III –Materials and Methods

Chapter IV- Results and Discussion

1.10. Research output/outcome if any published or presented in conference/seminar/symposium may be included.

1.11. List of References - Any works of other researchers, if used either directly or indirectly, should be indicated at appropriate places in the report/thesis. The citation may assume any one of the following forms. **APA Style.**

APA in-text citation style uses the author's last name and the year of publication, for example: (Field, 2005).

Example:

Derwing, T. M., Rossiter, M. J., & Munro, M. J. (2002). Teaching native speakers to listen to foreign-accented speech. *Journal of Multilingual and Multicultural Development*, 23(4), 245-259.

Thomas, H. K. (2004). *Training strategies for improving listeners' comprehension of foreign-accented speech* (Doctoral dissertation). University of Colorado, Boulder.

6. TYPING INSTRUCTIONS

6.1 General

This section includes additional information for final typing of the thesis. Some information given earlier under 'Manuscript preparation' shall also be referred. The impressions on the typed/duplicated/printed copies should be black in colour. Corrections, interlineations and crossing out of letters or words will not be permitted in any of the copies of the report/thesis intended for submission. Erasures, if made, should be neatly carried out in all copies. A sub-heading at the bottom of a page must have at least two full lines below it or else it should be carried over to the next page. The last word of any page should not be split using a hyphen. One and a half spacing should be used for typing the general text. The general text shall be typed in Font Style Times New Roman and Font Size 12.

Single spacing should be used for typing:

- (i) Long Tables
- (ii) Long quotations
- (iii) Foot notes
- (iv) Multilane captions
- (v) References

Handwritten signature and date: 13/6/14

6.2 Chapters The format for typing chapter headings, division headings and sub division headings shall be same as given in Table of Contents.

7. BINDING SPECIFICATIONS

Thesis should be spiral or soft cover book bound, the cover of thesis should be of dark green color, printed with golden ink and the text for printing should be identical as prescribed for the title page.

Signature
13/6/2015 *mu*

APPENDIX I A: (A typical Specimen of Cover Page & Title Page—DISSERTATION REPORT)

TITLE OF DISSERTATION REPORT

<1.5 line spacing>



DISSERTATION

Submitted by

<Italic>

NAME OF THE CANDIDATE

Under the Supervision of

NAME OF THE SUPERVISOR

in partial fulfillment for the award of the degree of

<1.5 line spacing>

MASTERS OF SCIENCE IN

NAME OF THE PROGRAMME

DEPARTMENT OF

SCHOOL OF

CENTRAL UNIVERSITY OF HARYANA,

MAHENDERGARH-HARYANA

<1.5 line spacing>

MONTH AND YEAR

Signature
13/6/2015

DECLARATION

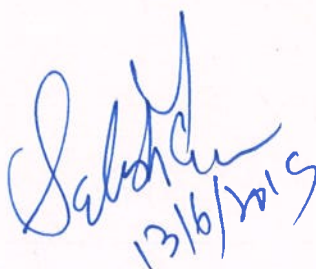
I, student of the School of Interdisciplinary and Life Sciences, Central University of Haryana, Mahendergarh hereby declare and certify with my signature that my thesis entitled

..... submitted to the Department of, Central University of Haryana, India in partial fulfillment of the requirements for the award of the Degree of Masters of Science is a record of original research work done by me and the dissertation has not been the basis for the award of any degree/diploma/associateship/fellowship or similar title of any candidate of any University. I have faithfully and accurately cited all my sources, including books, journals, handouts and unpublished manuscripts, as well as any other media, such as the Internet, letters or significant personal communications.

I understand the concept of "plagiarism" and declare that while drafting this dissertation I have refrained from plagiarism. I know that plagiarism not only includes direct copying, but also the extensive use of other's ideas without proper referencing or acknowledgement (which includes the proper use of references and quotation marks).

If my dissertation found to be plagiarized at any point of time, I'll be solely responsible and will be ready to accept any decision taken by the competent authority including rejection of my dissertation.

(Signature of student)


13/6/2019



APPENDIX – I B: (A typical Specimen of Certificate)

Font Style <Times New Roman >

CENTRAL UNIVERSITY OF HARYANA

CERTIFICATE

This is to certify that the dissertation entitled “**TITLE OF THE DISSERTATION**”, submitted to the Department of, Central University of Haryana, India in partial fulfillment of the requirements for the award of the Degree of Masters of Science in is a record of original research work done by **NAME OF THE CANDIDATE (Roll No.....)**, in the..... (Place of research) under my guidance. It is further certified that to the best of our knowledge the dissertation has not been the basis for the award of any degree/diploma/associateship/fellowship or similar title of any candidate of any University so far.

<<Signature of the Supervisor with date>>

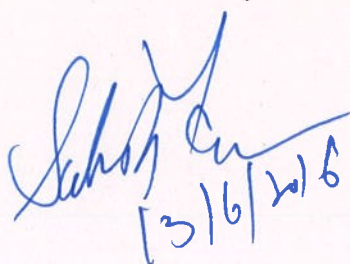
<<Name of the Supervisor >>

<<Academic Designation of Supervisor>>

<<Name of Division/Centre>>

Central University of Haryana

Mahendergarh-123031


13/6/2018




For example

(A typical Specimen of Table of Contents)

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	iii
	LIST OF TABLES	xvi
	LIST OF FIGURES	xviii
	LIST OF SYMBOLS, ABBREVIATIONS	xxvii
1	INTRODUCTION	1
	1.1 GENERAL	1
	1.2 NEED FOR THE STUDY	2
	1.3 OBJECTIVES OF THE STUDY	3
2	REVIEW OF LITERATURE	4
	2.1 INTRODUCTION	4
	2.2	4
	2.2.1 Product	6
	2.2.2 Product....	6


13/6/2019

ANNEXURE II

Curriculum vitae

Personal Details

Name :

Date of birth : DD Month, YYYY

Place of birth :

Nationality : Indian

Permanent Address :

Email Id :

Mobile No. :

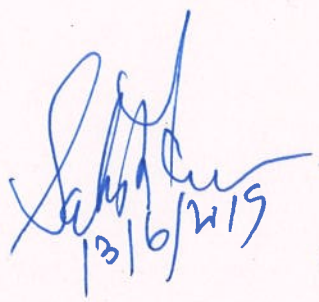
Education

M.Sc. (Subject) : YYYY Central University of Haryana, India

B.Sc. (Subject). : YYYY (Name of the University) with % of marks

Higher Secondary : YYYY (Name of the board) with % of marks

Secondary : YYYY, (Name of the board) with % of marks


13/6/2019

**CENTRAL UNIVERSITY OF HARYANA
MAHENDERGARH**

(Established vide Central Universities Act 2009)

NAAC Accredited 'A' Grade University



SCHEME, SYLLABUS AND COURSES OF READING

Offered by the Department of Sanskrit for

M. A. SANSKRIT

SEMESTERS : I & II

(Proposed w.e.f. the Academic Session : 2019-2020)

Semester – I

Examination : December, 2019

Semester – II

Examination : May, 2020

(Approved in the Meeting of BOS Held on 10th April 2019.)

Central University of Haryana, Mahendergarh
(Established vide Central Universities Act 2009)
NAAC Accredited 'A' Grade University

DEPARTMENT OF SANSKRIT,
Credit Matrix for M.A. Sanskrit
w.e.f. 2019-2020

Semesters	Core Course (CC)	Discipline Centric Elective Courses (DCEC)	Interdisciplinary/ Generic Elective Course (GEC)	Viva Voce	Total
I	20	-	-	-	20
II	20	-	4	2	26
III	4	20	4	-	28
IV	4	20	-	2	26
Total	48	40	8	4	100

Instructions for the Students:

Course Type

Core Course (CC): There are core courses in every semester. These courses are to be compulsorily studied by a student as a core course to complete the requirement of a programme in a said discipline of study.

Discipline Centric Elective Courses (DCEC): These are Elective courses and can be chosen from a pool of papers in Semester III and IV. It will be supportive to gain in depth reach in a particular field of Sanskrit and mandatory as per course curriculum.

Generic Elective Course (GEC): Generic Elective Course may be from an unrelated discipline. It is interdisciplinary/open elective as per course curriculum. Available/offered by the departments included in the School or can be taken from the GEC Course offered by the Dept. of Sanskrit.

DEPARTMENT OF SANSKRIT
M.A. SANSKRIT
CHOICE BASED CREDIT SYSTEM

Semester-I (w.e.f. 2018-2019)

Course Code	Title of Paper	L	T	P	Credits	Marks		Hrs.	Duration of Exam. (Hrs.)
						Theory	Int. Ass.		
SLLCH SKT 1101 C 3104	Samhitā Upaniṣat Ca	3	1	-	4	70	30	3+1	3
SLLCH SKT 1102 C 3104	Vyākaraṇaṁ Bhāṣāvijñānaṁ Ca (1)	3	1	-	4	70	30	3+1	3
SLLCH SKT 1103 C 3104	Bhāratīyadarśanaṁ (1)	3	1	-	4	70	30	3+1	3
SLLCH SKT 1104 C 3104	Kāvyaṁ Nāṭakaṁ Ca	3	1	-	4	70	30	3+1	3
SLLCH SKT 1105 C 3104	Dharmaśāstraṁ (1)	3	1	-	4	70	30	3+1	3
Total		15	05	-	20	350	150	15+05	
Grand Total						500			

Semester-II (w.e.f. 2019-2020)

Course Code	Title of Paper	L	T	P	Credits	Marks		Hrs.	Duration of Exam. (Hrs.)
						Theory	Int. Ass.		
SLLCH SKT 1206 C 3104	Brāhmaṇam Vedāṅgāni Ca	3	1	-	4	70	30	3+1	3
SLLCH SKT 1207 C 3104	Vyākaraṇaṁ Bhāṣāvijñānaṁ Ca (2)	3	1	-	4	70	30	3+1	3
SLLCH SKT 1208 C 3104	Bhāratīyadarśanaṁ (2)	3	1	-	4	70	30	3+1	3
SLLCH SKT 1209 C 3104	Kāvyaṁ Kāvyaśāstraṁ Ca	3	1	-	4	70	30	3+1	3
SLLCH SKT 1210 C 3104	Dharmaśāstraṁ (2)	3	1	-	4	70	30	3+1	3
SLLCH SKT 1201 V 0002	Viva-Voce (will be held only in Sanskrit Medium).	-	-	-	2	50	-	-	
Total		15	05		22	400	150	15+05	
Grand Total						550			
SLLCH SKT 1101 GE 3003	Prācinabhāratīyasaṁskṛtiḥ Darśanaṁ Bhāṣāvijñānaṁ Ca (1)	3	1	-	4	70	30	3+1	3
Grand Total		3	1	-	4	100		3+1	

M.A. Sanskrit Semesters: I & II

योजना, पाठ्यक्रमः, पाठचर्या च

(2019-2020 शैक्षिकसत्रतः प्रस्तावितम्)

SCHEME, SYLLABUS AND COURSES OF READING

(Proposed w.e.f. the Academic Session: 2019-2020)

एम०ए० (संस्कृत)-कक्ष्यायाः प्रथमवर्षीयपाठ्यक्रमः सत्रद्वये (प्रथमसत्रे द्वितीयसत्रे च) विभक्तः वर्तते। तत्र प्रतिसत्रम् अध्ययनार्थं पञ्च पत्राणि निर्धारितानि सन्ति। द्वितीयसत्रस्य पाठ्यक्रमसमाप्तेः अनन्तरं प्रथमद्वितीयसत्रयोः अधीतं पाठ्यक्रमम् आश्रित्य छात्राणां संस्कृतमाध्यमेन मौखिकी परीक्षा आयोजयिष्यते। एतदर्थं 50 अङ्काः निर्धारिताः सन्ति।

द्वितीयसत्रे चयनाधारितश्रेयोदानपद्धत्यनुसारेण विश्वविद्यालयस्य संस्कृतेतरछात्रेभ्यः एकम् वैकल्पिकं पत्रं वर्तते। एतदर्थं 70 अङ्काः, आन्तरिकमूल्याङ्कनाय च 30 अङ्काः निर्धारिताः सन्ति।

लिखितपत्राणां परीक्षासमयः प्रतिपत्रं 3 होराः भविष्यति। प्रत्येकं लिखितपत्राय सप्ततिः (70) अङ्काः विद्यन्ते। एतदतिरिक्तं प्रतिपत्रं त्रिंशत् (30) अङ्काः आन्तरिकमूल्याङ्कनाय अधोनिर्दिष्टरूपेण निर्धारिताः सन्ति –

(i)	प्रतिपत्रम् एका परीक्षा संगोष्ठी वा	:	50% = 15 अङ्काः
(ii)	एका कक्ष्यापरीक्षा	:	30% = 09 अङ्काः
(iii)	कक्ष्यायाम् उपस्थितिः	:	20% = 06 अङ्काः
	कक्ष्यायाम् उपस्थितेः अधोलिखितरीत्या अङ्काः प्रदास्यन्ते-		
(1)	91% तोऽग्रे	:	6 अङ्काः
(2)	81% तः 90% पर्यन्तम्	:	5 अङ्काः
(3)	75% तः 80% पर्यन्तम्	:	4 अङ्काः
(4)	70% तः 74% पर्यन्तम्	:	3 अङ्काः
(5)	65% तः 69% पर्यन्तम्	:	2 अङ्कः

The first year syllabus of M.A. Sanskrit class is bifurcated into two semesters, namely, Semester-I and Semester-II. Five papers are prescribed for study in each Semester. Viva-Voce of the students, based on the syllabus covered in their 1st and 2nd Semester courses, will be conducted through **Sanskrit medium** after the completion of the syllabus of M.A. Sanskrit, Second Semester. Viva-Voce carries 50 marks.

One Open Elective (Interdisciplinary) paper, also called Generic Elective Course (GEC) carrying 70 marks + 30 marks for Internal Assessment, has been prescribed in the 2nd Semester under Choice Based Credit System for the students of other than Sanskrit subjects of CUH.

The time for examination in each theory paper will be 3 (three) hours. Each theory paper in the 1st & the 2nd semester carries 70 (Seventy) marks. Besides, each paper has been assigned 30 (Thirty) marks for Internal Assessment as per the following scheme:

(i)	One Test/Seminar for each paper	:	50% = 15 Marks
(ii)	One Class Test (one period duration)	:	30% = 09 Marks
(iii)	Marks for Attendance will be given as under	:	20% = 06 Marks
(1)	91% onwards	:	6 Marks
(2)	81% to 90%	:	5 Marks
(3)	75% to 80%	:	4 Marks
(4)	70% to 74%	:	3 Marks
(5)	65% to 69%	:	2 Mark

लिखितपत्राणां विस्तृतः पाठ्यक्रमः
(2019-2020 शैक्षिकसत्रतः संशोधितः)
Detailed Syllabus for written papers
(Proposed w.e.f. Academic Session 2019-2020)

एम० ए० संस्कृतम् प्रथमं सत्रम्
M.A. SANSKRIT FIRST SEMESTER
COURSE CODE : SLLCH SKT 1101 C 3104
प्रथमपत्रम् : संहिता उपनिषत् च
Paper-I : Samhitā Upaniṣat Ca

L	T	P	Credits
3	1	-	4

पूर्णाङ्काः 70

आन्तरिकमूल्याङ्कनाङ्काः 30

समयः 3 होराः (3 Hours)

- घटकम्-1:** निम्नलिखितसूक्तानां पारम्परिक्या आधुनिक्या आलोचनात्मकपद्धत्या च गहनम् अध्ययनम् - **14अङ्काः**
ऋग्वेदः -अग्निः1 (1.1); सविता (1.35); विष्णुः (1.154); इन्द्रः (2.12);
रुद्रः (2.33); बृहस्पतिः (4.50); उषाः (5.80); वरुणः (7.88); सोमः (9.80)।
- घटकम्-2:** निम्नलिखितसूक्तानां पारम्परिक्या आधुनिक्या आलोचनात्मकपद्धत्या च गहनम् अध्ययनम् - **14अङ्काः**
ऋग्वेदः -पुरुषः (10.90); हिरण्यगर्भः (10.121); नासदीयम् (10.129); वाक् (10.125);
सरमा-पणि-संवादः (10-108); विश्वामित्र-नदी-सूक्तम् (3.33)।
- घटकम्-3:** निम्नलिखितसूक्तानां पारम्परिक्या आधुनिक्या आलोचनात्मकपद्धत्या च गहनम् अध्ययनम् - **14अङ्काः**
यजुर्वेदः -शिवसंकल्पमन्त्राः 34.1-6; **अथर्ववेदः** (शौनकः) ब्रह्मचर्य सूक्तम् (11.5) भूमिसूक्तम् (12.1)।
- घटकम्-4:** ईशावास्योपनिषद्, केनोपनिषद् विशदव्याख्यामात्रम् **14अङ्काः**
सर्वघटकानां सम्मिलितः प्रश्नः - **14 अङ्काः**

प्रश्नपत्रनिर्माणविधिः

1. प्रश्नपत्रस्य निर्माणं **संस्कृतमाध्यमेन** भवेत्।
2. प्रश्नपत्रे **पञ्च (5)** अनिवार्याः प्रश्नाः भविष्यन्ति। **प्रथमः प्रश्नः संस्कृतमाध्यमेन एव समाधेयः।** अन्ये प्रश्नाः संस्कृत-हिन्दी-आंग्लभाषा-माध्यमेन वा यथेच्छं समाधेयाः।
3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति-
 - I. प्रथमः प्रश्नः - **घटकचतुष्टयगतपाठ्यक्रममाश्रित्य** भवेत्। अस्मिन् प्रश्ने **सप्त (7)** विकल्परहिताः संक्षिप्तोत्तरप्रश्नाः प्रदास्यन्ते। (7X2=14अङ्काः)
 - II. द्वितीयः प्रश्नः (प्रथमद्वितीयघटकाश्रितः) - पारम्परिक्या आधुनिक्या आलोचनात्मकपद्धत्या च **मन्त्रद्वयं** व्याख्यातुं प्रथमद्वितीयघटकोक्तसूक्तेभ्यः **मन्त्रचतुष्टयं** प्रदास्यते। (2X7=14अङ्काः)
 - III. तृतीयः प्रश्नः (प्रथमद्वितीयघटकाश्रितः) -
(क) यथानिर्दिष्टसूक्तसम्बद्धम् आलोचनात्मकं **प्रश्नद्वयं** समाधातुं **प्रश्नचतुष्टयं** प्रदास्यते। (2X7=14अङ्काः)

- IV. चतुर्थः प्रश्नः (तृतीयघटकाश्रितः) - पारम्परिक्या आधुनिक्या आलोचनात्मकपद्धत्या च **मन्त्रद्वयं** व्याख्यातुं
चत्वारः मन्त्राः प्रदास्यन्ते। (2X7=14अङ्काः)
- V. पञ्चमः प्रश्नः (चतुर्थघटकाश्रितः) - **मन्त्रद्वयस्य** विशदव्याख्यार्थं **मन्त्रचतुष्टयं** प्रदास्यते।
 (2X7=14अङ्काः)

अनुशंसितग्रन्थाः

1. ऋग्वेद, स्वामी-दयानन्द-सरस्वती-भाष्यसहित, प्रका०-परोपकारिणी सभा, अजमेर-2014
2. ऋग्वेद, सप्तम-अष्टम-नवम-मण्डल, आर्यमुनि-भाष्यसहित, प्रका०-परोपकारिणी सभा, अजमेर-1989
3. ऋग्वेद, दशम-मण्डल, ब्रह्ममुनिपरिव्राजक-भाष्यसहित, प्रका०-परोपकारिणी सभा, अजमेर-1988
4. ऋग्वेद, सायणभाष्यसहिता, वैदिक संशोधन मण्डल, पूना
5. यजुर्वेद, स्वामी दयानन्द सरस्वती-भाष्यसहित, प्रका० परोपकारिणी सभा, अजमेर-2012
6. उव्वट-महीधरकृत शुक्लयजुर्वेदभाष्य
7. सुबोधभाष्य : दामोदरपाद सातवलेकर, वैदिक स्वाध्यायमण्डल पारडी।
8. The New Vedic Selection, Part I & II (Revised and Enlarged Edition), Braj Bihari Chaubey, Bharatiya Vidya Prakashan, Delhi-7.
9. Vedic Selection, A.A. Macdonell, Motilal Banarsidass, Delhi
10. Hymns of the Atharvaveda - M. Bloomfield, Motilal Banarsidass, Delhi
11. अथर्ववेद, विश्वनाथ विद्यालङ्कार-भाष्यसहित, वैदिक पुस्तकालय, केसरगंज, अजमेर-2013
12. ईशावास्योपनिषद् (शाङ्करभाष्य), गीता प्रेस, गोरखपुर
13. ऋक्सूक्तसंग्रह, कृष्ण कुमार एवं हरिदत्त शास्त्री, साहित्य भण्डार, मेरठ

COURSE CODE : SLLCH SKT 1102 C 3104

द्वितीयपत्रम् : व्याकरणं भाषाविज्ञानञ्च (1)

Paper-II : Vyākaraṇaṁ Bhāṣāvijñānañca (1)

L	T	P	Credits
3	1	-	4

पूर्णाङ्काः 70

आन्तरिकमूल्याङ्कनाङ्काः 30

समयः 3 होराः (3 Hours)

घटकम्-1: वरदराजः - लघुसिद्धान्तकौमुदी

14अङ्काः

सूत्राणां सोदाहरणं व्याख्या, रूपसिद्धिप्रक्रिया च-

(क) सञ्ज्ञाप्रकरणम्; (ख) सन्धिप्रकरणम्।

संबद्ध सूत्राणां सोदाहरणं व्याख्या, रूपसिद्धिप्रक्रिया च।

घटकम्-2: वरदराजः - लघुसिद्धान्तकौमुदी

14अङ्काः

सुबन्तप्रकरणम् :-

(क) अजन्तपुंल्लिङ्गप्रकरणम्- राम, सर्व, हरि, सखि, गो।

(ख) अजन्तस्त्रीलिङ्गप्रकरणम्- रमा, सर्वा, मति, स्त्री।

(ग) अजन्तनपुंसकलिङ्गप्रकरणम्- ज्ञान, वारि, दधि, मधु।

(घ) हलन्तपुंल्लिङ्गप्रकरणम्- विश्ववाह, मघवन्, राजन्, विद्वस्, तद्, युष्मद्, अस्मद्।

संबद्ध सूत्राणां सोदाहरणं व्याख्या, रूपसिद्धिप्रक्रिया च-

घटकम्-3: वरदराजः - लघुसिद्धान्तकौमुदी

14अङ्काः

(क) तिङन्ते भ्वादिप्रकरणम्- √भू, √एध् (एतयोः सर्वे लकाराः)।

(ख) पूर्वकृदन्तप्रकरणम्।

संबद्ध सूत्राणां सोदाहरणं व्याख्या प्रमुखसूत्रोल्लेखपूर्वकं रूपसिद्धिप्रक्रिया च।

घटकम्-4: भाषाविज्ञानम्

14अङ्काः

भाषाविज्ञानस्य परिभाषा क्षेत्रं च। भाषायाः परिभाषा वैशिष्ट्यानि च। भाषागतपरिवर्तनं

तद्भेदाश्च। भाषापरिवर्तनस्य कारणानि। भाषापरिवाराः (रूपरेखामात्रम्)। भाषाणां वर्गीकरणम्

(परिवारमूलकम् आकृतिमूलकं च)। भारोपीयपरिवारः (सामान्यमध्ययनम्)। इण्डो-इरानियन-शाखा

(विशिष्टमध्ययनम्)।

सर्वघटकानां सम्मिलितः प्रश्नः - **14 अङ्काः**

प्रश्नपत्रनिर्माणविधिः

1. प्रश्नपत्रस्य निर्माणं **संस्कृतमाध्यमेन** भवेत्।

2. प्रश्नपत्रे **पञ्च (5)** अनिवार्याः प्रश्नाः भविष्यन्ति। **प्रथमः प्रश्नः संस्कृतमाध्यमेन एव समाधेयः।** अन्ये प्रश्नाः संस्कृत-हिन्दी-आंग्लभाषा-माध्यमेन वा यथेच्छं समाधेयाः।

3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति-

I. प्रथमः प्रश्नः - **घटकचतुष्टयगतपाठ्यक्रममाश्रित्य** भवेत्। अस्मिन् प्रश्ने **सप्त (7)** विकल्परहिताः

संक्षिप्तोत्तरप्रश्नाः प्रदास्यन्ते।

(7X2=14अङ्काः)

II. द्वितीयः प्रश्नः (प्रथमघटकाश्रितः)-

(क) **सूत्रद्वयं** सोदाहरणं व्याख्यातुं **सूत्रचतुष्टयं** प्रदास्यते।

(2X3=6अङ्काः)

(ख) प्रथमघटकोक्तप्रकरणसम्बद्धस्य **पदद्वयस्य** प्रमुखसूत्रोल्लेखपूर्वकं रूपसिद्धिप्रक्रियां लिखितुं

पदचतुष्टयं प्रदास्यते।

(2X4=8अङ्काः)

III. तृतीयः प्रश्नः (द्वितीयघटकाश्रितः)-

(क) द्वितीयघटकोक्तप्रकरणसम्बद्धं **सूत्रद्वयं** सोदाहरणं व्याख्यातुं **सूत्रचतुष्टयं** प्रदास्यते।

(2X3=6अङ्काः)

(ख) द्वितीयघटकोक्तप्रकरणसम्बद्धस्य **पदद्वयस्य** प्रमुखसूत्रोल्लेखपूर्वकं रूपसिद्धिप्रक्रियां लिखितुं

पदचतुष्टयं प्रदास्यते।

(2X4=8अङ्काः)

IV. चतुर्थः प्रश्नः (तृतीयघटकाश्रितः)-

(क) **सूत्रद्वयं** सोदाहरणं व्याख्यातुं **सूत्रचतुष्टयं** प्रदास्यते।

(2X3=6अङ्काः)

(ख) **पदद्वयस्य** सूत्रोल्लेखपूर्वकं रूपसिद्धिप्रक्रियार्थं **पदचतुष्टयं** प्रदास्यते।

(2X4=8अङ्काः)

V. पञ्चमः प्रश्नः (चतुर्थघटकाश्रितः)-

समीक्षात्मकं **प्रश्नद्वयं** समाधातुं **प्रश्नचतुष्टयं** प्रदास्यते।

(2X7=14अङ्काः)

अनुशंसितग्रन्थाः

1. लघुसिद्धान्तकौमुदी, व्याख्या० श्रीधरानन्द शास्त्री घिल्डियाल, मोतीलाल बनारसीदास, दिल्ली।

2. लघुसिद्धान्तकौमुदी, वरदराज, व्याख्या० भीमसेन शास्त्री, भैमी प्रकाशन, दिल्ली।

3. भाषा और भाषिकी, देवीशंकर द्विवेदी, हरियाणा साहित्य अकादमी, चण्डीगढ़।

4. पदपदार्थसमीक्षा, बलदेव सिंह, कुरुक्षेत्र विश्वविद्यालय, कुरुक्षेत्र।

5. सामान्य भाषा-विज्ञान, बाबूराम सक्सेना।

6. Introduction to Comparative Philology, P.D. Gune, Pune. (Hindi Translation is also available).

7. Transformational Grammar, Ratford, A., Cambridge Univ. Press, 1988.

8. Introduction to Linguistics, Ratford, A. et. al., Cambridge Univ. Press, 1999.
9. Introduction to Theoretical Linguistics, Lyons, John, 1968.
10. Linguistic Semantics, Lyons, John, Cambridge University Press, 1995.
11. General Linguistics, An Introductory Survey, Robins, R. H., Indiana Press, Blomington, 1964.
12. Introduction to Government and Binding Theory, Haegeman, L., Basil Basil Blackwell, 1994.
13. Linguistics, An Introduction to Language and Communication, Akmaijan, A.R. Demers and R. Hamish, Cambridge Mass, MIT Press. 1979.

COURSE CODE : SLLCH SKT 1103 C 3104

तृतीयपत्रम् : भारतीयदर्शनम् (1)

Paper-III : Bhāratīyadarśanam (1)

L	T	P	Credits
3	1	-	4

पूर्णाङ्काः 70

आन्तरिकमूल्याङ्कनाङ्काः 30

समयः 3 होराः (3 Hours)

- घटकम्-1:** केशवमिश्रः-तर्कभाषा : आरम्भतः प्रत्यक्षप्रमाणपर्यन्तम् 14 अङ्काः
- घटकम्-2:** तर्कभाषा : अनुमानप्रमाणतः प्रामाण्यवादपर्यन्तम् 14 अङ्काः
- घटकम्-3:** ईश्वरकृष्णः-सांख्यकारिका (तत्त्वकौमुदी) : आरम्भतः 25 कारिकापर्यन्तम् 14 अङ्काः
- घटकम्-4:** सांख्यकारिका (तत्त्वकौमुदी) : 26 कारिकातः समाप्तिपर्यन्तम् 14 अङ्काः
- सर्वघटकानां सम्मिलितः प्रश्नः - 14 अङ्काः

प्रश्नपत्रनिर्माणविधिः

1. प्रश्नपत्रस्य निर्माणं संस्कृतमाध्यमेन भवेत्।
2. प्रश्नपत्रे पञ्च (5) अनिवार्याः प्रश्नाः भविष्यन्ति। प्रथमः प्रश्नः संस्कृतमाध्यमेन एव समाधेयः। अन्ये प्रश्नाः संस्कृत-हिन्दी-आंग्लभाषा-माध्यमेन वा यथेच्छं समाधेयाः।
3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति-
 - I. प्रथमः प्रश्नः – घटकचतुष्टयगतपाठ्यक्रममाश्रित्य सप्त (7) विकल्परहिताः संक्षिप्तोत्तरप्रश्नाः प्रदास्यन्ते। (7X2=14अङ्काः)
 - II. द्वितीयः प्रश्नः (प्रथमघटकाश्रितः) – (क) सिद्धान्तरूपं प्रश्नमेकं समाधातुं प्रश्नद्वयं प्रदास्यते। (6अङ्काः)
(ख) पंक्तिद्वयं व्याख्यातुं पंक्तिचतुष्टयं प्रदास्यते। (2X4=8अङ्काः)
 - III. तृतीयः प्रश्नः (द्वितीयघटकाश्रितः) – (क) सप्रसङ्गं पङ्क्तिद्वयं व्याख्यातुं यथानिर्दिष्टग्रन्थात् पङ्क्तित्रयं प्रदास्यते। (2X3=6अङ्काः)
(ख) पंक्तिद्वयं व्याख्यातुं पंक्तिचतुष्टयं प्रदास्यते। (2X4=8अङ्काः)
 - IV. चतुर्थः प्रश्नः (तृतीयघटकाश्रितः) -
(क) सिद्धान्तरूपं प्रश्नमेकं समाधातुं प्रश्नद्वयं प्रदास्यते। (7अङ्काः)
(ख) कारिकामेकं विस्तरेण व्याख्यातुं कारिकाद्वयं प्रदास्यते। (7अङ्काः)
 - V. पञ्चमः प्रश्नः (चतुर्थघटकाश्रितः) -
(क) सिद्धान्तरूपं प्रश्नमेकं समाधातुं प्रश्नद्वयं प्रदास्यते। (7अङ्काः)
(ख) कारिकामेकं विस्तरेण व्याख्यातुं कारिकाद्वयं प्रदास्यते। (7अङ्काः)

अनुशंसितग्रन्थाः

1. तर्कभाषा, व्याख्याकार श्रीनिवास शास्त्री, साहित्य भण्डार, मेरठ।
2. तर्कभाषा, व्याख्याकार बदरीनाथ शुक्ल, मोतीलाल बनारसीदास, दिल्ली।
3. तर्कभाषा, व्याख्याकार गजानन शास्त्री मुसलगाँवकर, चौखम्बा, वाराणसी।
4. Tarkabhāṣā, Eng. Tr. S.R. Iyer, Varanasi.
5. Tarkabhāṣā, Eng. Tr. A.B. Gajendragadkar.
6. सांख्यतत्त्वकौमुदीप्रभा, सम्पादन एवं व्याख्याकार आद्याप्रसाद मिश्र, अक्षयवट प्रकाशन, इलाहाबाद।
7. सांख्यकारिका, सम्पादन तथा व्याख्याकार गजाननशास्त्री मुसलगाँवकर, चौखम्बा, वाराणसी।
8. Sāṃkhyakārikā, Eng. Tr. by Wilson, Delhi.

COURSE CODE : SLLCH SKT 1104 C 3104

चतुर्थपत्रम् : काव्यम् नाटकम् च

Paper-IV : Kāvyaṃ Nāṭakaṃ Ca

L	T	P	Credits
3	1	-	4

पूर्णाङ्काः 70

आन्तरिकमूल्याङ्कनाङ्काः 30

समयः 3 होराः (3 Hours)

घटकम्-1: माघः - शिशुपालवधम्, प्रथमः सर्गः।

14अङ्काः

घटकम्-2: भवभूतिः - उत्तररामचरितम्, 1-3 अङ्काः।

14अङ्काः

घटकम्-3: उत्तररामचरितम्, 4-7 अङ्काः।

14अङ्काः

घटकम्-4: कालिदासः - मेघदूतम् (पूर्वमेघः)।

14अङ्काः

सर्वघटकानां सम्मिलितः प्रश्नः - 14 अङ्काः

प्रश्नपत्रनिर्माणविधिः

1. प्रश्नपत्रस्य निर्माणं संस्कृतमाध्यमेन भवेत्।
2. प्रश्नपत्रे पञ्च (5) अनिवार्याः प्रश्नाः भविष्यन्ति। प्रथमः प्रश्नः संस्कृतमाध्यमेन एव समाधेयः। अन्ये प्रश्नाः संस्कृत-हिन्दी-आंग्लभाषा-माध्यमेन वा यथेच्छं समाधेयाः।
3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति-
 - I. प्रथमः प्रश्नः - घटकचतुष्टयगतपाठ्यक्रममाश्रित्य भवेत्। अस्मिन् प्रश्ने सप्त (7) विकल्परहिताः संक्षिप्तोत्तरप्रश्नाः प्रदास्यन्ते। (7X2=14अङ्काः)
 - II. द्वितीयः प्रश्नः (प्रथमघटकाश्रितः) - सप्रसङ्गं छन्दोऽलङ्कारनिर्देशपूर्वकं श्लोकद्वयं व्याख्यातुं श्लोकचतुष्टयं प्रदास्यते। (2X7=14अङ्काः)
 - III. तृतीयः प्रश्नः (द्वितीयतृतीयघटकाश्रितः) - प्रश्नद्वयं समाधातुं उत्तररामचरितस्य सामान्यमध्ययनमाश्रित्य पार्श्वभूमिः, नाट्यकलागुणाः, चरित्रचित्रणमित्यादिः लेखनार्थं प्रश्नचतुष्टयं प्रदास्यते। (2X7=14अङ्काः)
 - IV. चतुर्थः प्रश्नः (तृतीयघटकाश्रितः) - (क) एकंश्लोकं व्याख्यातुं श्लोकद्वयं प्रदास्यते। (6अङ्काः)
(ख) विशिष्टपंक्तिद्वयं व्याख्यातुं पंक्तिचतुष्टयं प्रदास्यते। (2X4=8अङ्काः)
 - V. पञ्चमः प्रश्नः (चतुर्थघटकाश्रितः) - सप्रसङ्गं छन्दोऽलङ्कारनिर्देशपूर्वकं श्लोकद्वयं व्याख्यातुं श्लोकचतुष्टयं प्रदास्यते। (2X7=14अङ्काः)

अनुशंसितग्रन्थाः

1. शिशुपालवध, व्याख्या० आचार्य शेषराज शर्मा, वाराणसी।
2. उत्तररामचरित, व्याख्या० वीरराघव, वाराणसी।
3. शिशुपालवध (प्रथम सर्ग), व्याख्या० डॉ० श्रीनिवास शास्त्री, साहित्य भण्डार, मेरठ।
4. Uttararāmacarita of Bhavabhūti, M.R. Kale, Motilal Banarsidass, Delhi-2016

5. उत्तररामचरित, सम्पा० तारिणीश झा
6. संस्कृत साहित्य का इतिहास, ए० बी० कीथ, अनु० मंगलदेव शास्त्री, मोतीलाल बनारसीदास, दिल्ली, 1978
7. संस्कृत साहित्य का इतिहास, बलदेव उपाध्याय, शारदा निकेतन, वाराणसी, 1978
8. संस्कृत नाटककार, कान्तिकिशोर भरतिया, प्रकाशन शाखा, सूचना विभाग, उत्तरप्रदेश, 1959
9. संस्कृत नाटक समीक्षा, प्रो० इन्द्रपालसिंह 'इन्द्र', साहित्य निकेतन, कानपुर, 1960
10. The Meghadūta of Kālidāsa, M.R. Kale, Motilal Banarsidass, Delhi-2015.

COURSE CODE : SLLCH SKT 1105 C 3104

पञ्चमपत्रम् : धर्मशास्त्रम् (1)

Paper-V : Dharmaśāstram (1)

L	T	P	Credits
3	1	-	4

पूर्णाङ्काः 70

आन्तरिकमूल्याङ्कनाङ्काः 30

समयः 3 होराः (3 Hours)

घटकम्-1: पी०वी० काणे - धर्मशास्त्रस्येतिहासः- प्रथमःभागः, प्रथमः खण्डः- धर्मस्य अर्थः, धर्मस्य उपादानाः, गौतम-धर्मसूत्रः, बौधायन-धर्मसूत्रः, आपस्तम्ब-धर्मसूत्रः, हिरण्यकेशि-धर्मसूत्रः, वसिष्ठ-धर्मसूत्रश्च- एतेषां पञ्च धर्मसूत्राणां सामान्यः परिचयः।

14अङ्काः

घटकम्-2: पी० वी० काणे - धर्मशास्त्रस्येतिहासः- प्रथमःभागः, द्वितीयः खण्डः - वर्णाः, वर्णानां कर्तव्यानि। आश्रमाः, तेषां कर्तव्यानि। विवाहः, अन्ये संस्काराः।

14अङ्काः

घटकम्-3: मनुस्मृतिः, प्रथमोऽध्यायः (कुल्लूकभट्टटीका)।

14अङ्काः

घटकम्-4: याज्ञवल्क्यस्मृति (मिताक्षराटीका), व्यवहाराध्याये अष्टमं दायदविभागप्रकरणं सम्पूर्णम्।

14अङ्काः

सर्वघटकानां सम्मिलितः प्रश्नः - 14 अङ्काः

प्रश्नपत्रनिर्माणविधिः

1. प्रश्नपत्रस्य निर्माणं संस्कृतमाध्यमेन भवेत्।
2. प्रश्नपत्रे पञ्च (5) अनिवार्याः प्रश्नाः भविष्यन्ति। प्रथमः प्रश्नः संस्कृतमाध्यमेन एव समाधेयः। अन्ये प्रश्नाः संस्कृत-हिन्दी-आंग्लभाषा-माध्यमेन वा यथेच्छं समाधेयाः।
3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति-

I. प्रथमः प्रश्नः - घटकचतुष्टयगतपाठ्यक्रममाश्रित्य सप्त (7) विकल्परहिताः संक्षिप्तोत्तरप्रश्नाः प्रदास्यन्ते।

(7X2=14अङ्काः)

II. द्वितीयः प्रश्नः (प्रथमघटकाश्रितः) – एकं विषयमधिकृत्य निबन्धलेखनार्थं विषयद्वयं प्रदास्यते। (14अङ्काः)

III. तृतीयः प्रश्नः (द्वितीयघटकाश्रितः) – टिप्पणीद्वयं लेखनार्थं टिप्पणीचतुष्टयं प्रदास्यते। (2X7=14अङ्काः)

IV. चतुर्थः प्रश्नः (तृतीयघटकाश्रितः) – (क) एकं प्रश्नं समाधातुं प्रश्नद्वयं प्रदास्यते। (6अङ्काः)

(ख) श्लोकद्वयं व्याख्यातुं श्लोकचतुष्टयं प्रदास्यते- (2X4=8अङ्काः)

V. पञ्चमः प्रश्नः (चतुर्थघटकाश्रितः) - (क) एकं प्रश्नं समाधातुं प्रश्नद्वयं प्रदास्यते। (6अङ्काः)

(ख) श्लोकद्वयं व्याख्यातुं श्लोकचतुष्टयं प्रदास्यते- (2X4=8अङ्काः)

अनुशंसितग्रन्थाः

1. मनुस्मृतिः, मन्वर्थमुक्तावलीसहिता, सं० वासुदेव शर्मा काशीकरः, निर्णयसागर प्रेस, मुम्बई, 1909
2. मनुस्मृतिः, मेधातिथि-मनुभाष्य-समेता, सम्पा० गङ्गानाथ झा, परिमल पब्लिकेशन्स, दिल्ली, 1998
3. History of Dharmashastra, Dr. P.V. Kane, Bhandarkar Oriental Research Institute, Poona -
4. याज्ञवल्क्यस्मृति, मिताक्षरा टीका सहित-
5. धर्मशास्त्र का इतिहास, पी० वी० काणे, अनु. अर्जुन चौबे काश्यप, भाग 1-5, उत्तर प्रदेश हिन्दी संस्थान, लखनऊ, चतुर्थ संस्करण -1992

एम० ए० संस्कृतम्, द्वितीयं सत्रम्
(2019-20 शैक्षिकसत्रतः)

M.A. SANSKRIT , SECOND SEMESTER

(w.e.f. Academic Session : 2019-20)

COURSE CODE : SLLCH SKT 1206 C 3104

षष्ठपत्रम् : ब्राह्मणम् वेदाङ्गानि च

Paper-VI : Brāhmaṇam Vedāṅgāni Ca

L	T	P	Credits
3	1	-	4

पूर्णाङ्काः 70

आन्तरिकमूल्याङ्कनाङ्काः 30

समयः 3 होराः (3 Hours)

घटकम्-1: ऐतरेयब्राह्मणम् : अध्यायः 33 (शुनःशेषाख्यानम्)।

14अङ्काः

घटकम्-2: निरुक्तम् – प्रथमोऽध्यायः - व्याख्या, आलोचनात्मकः प्रश्नः।

14अङ्काः

घटकम्-3: निरुक्तम् – द्वितीयोऽध्यायः (1-5 पादाः); सप्तमः अध्यायः (1-7 पादाः)। आलोचनात्मकः

प्रश्नः निर्वचनानि च।

14अङ्काः

घटकम्-4: वैदिकं व्याकरणम् -

वैदिकभाषायाः स्वरूपम्; वैदिकलौकिकभाषयोः अन्तरम्; सन्धिः; पदपाठः; वैदिकस्वरः;

लुङ् लकारः; लेट् लकारः। प्रत्ययाः - शतृ, शानच्, क्वसु, कानच्, तुमर्थकाः।

14अङ्काः

सर्वघटकानां सम्मिलितः प्रश्नः - 14 अङ्काः

प्रश्नपत्रनिर्माणविधिः

1. प्रश्नपत्रस्य निर्माणं संस्कृतमाध्यमेन भवेत्।
2. प्रश्नपत्रे पञ्च (5) अनिवार्याः प्रश्नाः भविष्यन्ति। प्रथमः प्रश्नः संस्कृतमाध्यमेन एव समाधेयः। अन्ये प्रश्नाः संस्कृत-हिन्दी-आंग्लभाषा-माध्यमेन वा यथेच्छं समाधेयाः।
3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति -

I. प्रथमः प्रश्नः - घटकचतुष्टयगतपाठ्यक्रममाश्रित्य सप्त (7) विकल्परहिताः संक्षिप्तोत्तरप्रश्नाः प्रदास्यन्ते।

(7X2=14अङ्काः)

II. द्वितीयः प्रश्नः (प्रथमघटकाश्रितः) -

(क) पाठांशद्वयं व्याख्यातुं पाठांशचतुष्टयं प्रदास्यते।

(2X4=8अङ्काः)

(ख) एकम् आलोचनात्मकं प्रश्नं समाधातुं प्रश्नद्वयं प्रदास्यते।

(6अङ्काः)

III. तृतीयः प्रश्नः (द्वितीयघटकाश्रितः) -

(क) पाठांशद्वयं व्याख्यातुं पाठांशचतुष्टयं प्रदास्यते।

(2X4=8अङ्काः)

(ख) एकं सैद्धान्तिकं प्रश्नं समाधातुं प्रश्नद्वयं प्रदास्यते।

(6अङ्काः)

IV. चतुर्थः प्रश्नः (तृतीयघटकाश्रितः) -

(क) निर्वचन-चतुष्टयस्य व्याख्यार्थं निर्वचनाष्टकं प्रदास्यते।

(2X4=8अङ्काः)

(ख) एकं सैद्धान्तिकं प्रश्नं समाधातुं प्रश्नद्वयं प्रदास्यते।

(6अङ्काः)

V. पञ्चमः प्रश्नः (चतुर्थघटकाश्रितः)। टिप्पणीद्वयं लेखनार्थं टिप्पणीचतुष्टयं प्रदास्यते। (2X7=14अङ्काः)

अनुशंसितग्रन्थाः

1. ऐतरेय-ब्राह्मण (द्वितीय भाग), सायणभाष्यसहित, सम्पादक एवम् अनुवादक डॉ० सुधाकर मालवीय, तारा प्रिंटिंग वर्क्स, वाराणसी।

2. निरुक्त, हिन्दी अनुवादक पं० शिवनारायण शास्त्री, इण्डोलॉजिकल बुक हाऊस, दिल्ली।
3. निरुक्त (भाग 1-2), स्कन्द-महेश्वर-कृत निरुक्तभाष्यटीका-सहित, संपा० लक्ष्मण स्वरूप, प्रका० पाणिनि, नई दिल्ली।
4. निरुक्त, दुर्गाचार्य-कृत वृत्ति-सहित, आनन्दाश्रम, पूना।
5. निरुक्तसम्मर्शः, ब्रह्ममुनि परिव्राजक, वैदिक यन्त्रालय, अजमेरा।
6. हिन्दी निरुक्त (अध्याय 1, 2, 7), व्याख्या० कपिलदेव शास्त्री, साहित्य भण्डार, मेरठ।
7. वैदिक व्याकरण (भाग 1-2), रामगोपाल, नैशनल पब्लिशिंग हाऊस, दिल्ली।
8. A Vedic Grammar for Students, A.A. Macdonell, Motilal Banarsidass, Delhi.
9. Nighantu and Nirukta, Dr. Laxman Sarup, Motilal Banarsidass, Jawahar Nagar, New Delhi.
10. ए वैदिक ग्रामर फॉर स्टुडेंट्स, अनु० सत्यव्रत शास्त्री, मोतीलाल बनारसीदास, दिल्ली।

COURSE CODE : SLLCH SKT 1207 C 3104

सप्तमपत्रम् : व्याकरण भाषाविज्ञानञ्च (2)

Paper-VII : Vyākaraṇaṁ Bhāṣāvijñānaṁ Ca (2)

L	T	P	Credits
3	1	-	4

पूर्णाङ्काः 70

आन्तरिकमूल्याङ्कनाङ्काः 30

समयः 3 होराः (3 Hours)

घटकम्-1: वरदराजः - लघुसिद्धान्तकौमुदी

14अङ्काः

(क) तिङन्ते अदादिप्रकरणम् :- √अद्, √अस्, (एतयोः सर्वे लकाराः)।

(ख) नामधातुप्रकरणम्। (ग) आत्मनेपदप्रक्रिया। (घ) परस्मैपदप्रक्रिया।

सूत्राणां सोदाहरणं व्याख्या रूपसिद्धिप्रक्रिया च

घटकम्-2: वरदराजः - लघुसिद्धान्तकौमुदी

14अङ्काः

(क) समासप्रकरणम्। (ख) तद्धितप्रकरणम् (चातुरर्थिकपर्यन्तम्)।

सूत्राणां सोदाहरणं व्याख्या रूपसिद्धिप्रक्रिया च-

घटकम्-3: भट्टोजिदीक्षितः - सिद्धान्तकौमुदी : कारकप्रकरणम्

14अङ्काः

(क) सोदाहरणं सूत्रव्याख्या। (ख) सूत्रोल्लेखपूर्वकं कारक-विभक्ति-प्रतिपादनम्।

घटकम्-4: भाषाविज्ञानम् -

14अङ्काः

संस्कृतभाषा (वैदिकी लौकिकी च)। **अर्थविज्ञानम्** - अर्थपरिवर्तनस्य कारणानि दिशश्च।

ध्वनिविज्ञानम् - उच्चारणावयवाः तेषां प्रकार्याणि च; ध्वनीनां वर्गीकरणम्।

रूपविज्ञानम् - शब्दनिर्माणम्; शब्दानां तत्त्वानि; धातुः प्रत्ययश्च। **वाक्यविज्ञानम्** - परिभाषा, स्वरूपं घटकाश्च।

सर्वघटकानां सम्मिलितः प्रश्नः - **14 अङ्काः**

प्रश्नपत्रनिर्माणविधिः

1. प्रश्नपत्रस्य निर्माणं **संस्कृतमाध्यमेन** भवेत्।
2. प्रश्नपत्रे **पञ्च (5)** अनिवार्याः प्रश्नाः भविष्यन्ति। **प्रथमः प्रश्नः संस्कृतमाध्यमेन एव समाधेयः।** अन्ये प्रश्नाः संस्कृत-हिन्दी-आंग्लभाषा-माध्यमेन वा यथेच्छं समाधेयाः।
3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति-
 - I. प्रथमः प्रश्नः - **घटकचतुष्टयगतपाठ्यक्रममाश्रित्य** भवेत्। अस्मिन् प्रश्ने **सप्त (7)** विकल्परहिताः संक्षिप्तोत्तरप्रश्नाः प्रदास्यन्ते। (7X2=14अङ्काः)
 - II. द्वितीयः प्रश्नः (प्रथमघटकाश्रितः)-

- (क) सूत्रद्वयं सोदाहरणं व्याख्यातुं सूत्रचतुष्टयं प्रदास्यते। (2X3=6अङ्काः)
- (ख) पदद्वयस्य प्रमुखसूत्रोल्लेखपूर्वकं रूपसिद्धिप्रक्रियां लिखितुं पदचतुष्टयं प्रदास्यते। (2X4=8अङ्काः)
- III. तृतीयः प्रश्नः (द्वितीयघटकाश्रितः) -
- (क) सूत्रद्वयं सोदाहरणं व्याख्यातुं सूत्रचतुष्टयं प्रदास्यते। (2X3=6अङ्काः)
- (ख) पदद्वयस्य प्रमुखसूत्रोल्लेखपूर्वकं रूपसिद्धिप्रक्रियां लिखितुं पदचतुष्टयं प्रदास्यते। (2X4=8अङ्काः)
- IV. चतुर्थः प्रश्नः (तृतीयघटकाश्रितः) -
- (क) सूत्रद्वयं सोदाहरणं व्याख्यातुं सूत्रचतुष्टयं प्रदास्यते। (2X4=8अङ्काः)
- (ख) पदद्वयस्य सूत्रोल्लेखपूर्वकं कारक-विभक्ति-प्रतिपादनाय चत्वारि पदानि प्रदास्यन्ते। (2X3=6अङ्काः)
- V. पञ्चमः प्रश्नः (चतुर्थघटकाश्रितः) - समीक्षात्मकं प्रश्नद्वयं समाधातुं प्रश्नचतुष्टयं प्रदास्यते। (2X7=14अङ्काः)

अनुशंसितग्रन्थाः

1. लघुसिद्धान्तकौमुदी, वरदराज, व्याख्याकार भीमसेन शास्त्री, भैमी प्रकाशन, दिल्ली।
2. लघुसिद्धान्तकौमुदी, व्याख्याकार, श्रीधरानन्द शास्त्री धिल्डियाल, मोतीलाल बनारसीदास, दिल्ली।
3. वैयाकरणसिद्धान्तकौमुदी (पूर्वार्द्ध), भट्टोजिदीक्षित, मोतीलाल बनारसीदास, दिल्ली।
4. वैयाकरणसिद्धान्तकौमुदी (1-2 भाग), व्याख्या० गोपालदत्त पाण्डेय, चौखम्बा सुरभारती प्रकाशन, वाराणसी।
5. कारक-प्रकरण (सिद्धान्तकौमुदीस्थ), सम्पादक तथा व्याख्याकार श्रीनिवास शास्त्री, साहित्य भण्डार, मेरठ।
6. भाषा और भाषिकी, देवीशंकर द्विवेदी, हरियाणा साहित्य अकादमी, चण्डीगढ़।
7. पदपदार्थसमीक्षा, बलदेव सिंह, कुरुक्षेत्र विश्वविद्यालय, कुरुक्षेत्र।
8. सामान्य भाषा-विज्ञान, बाबूराम सक्सेना।
9. Introduction to Comparative Philology, P.D. Gune, Pune; (Its Hindi translation is also available).
10. Transformational Grammar, Ratford, A., Cambridge University Press, 1988.
11. Introduction to Linguistics, Ratford, A. et. al., Cambridge University Press, 1999.
12. (a) Introduction to Theoretical Linguistics, Lyons, John, 1968.
(b) Linguistic Semantics, Lyons, John, Cambridge University Press, 1995
13. General Linguistics, An Introductory Survey, Robins, R. H., Indiana Press, Bloomington, 1964.
14. An Introduction to the Science of Meaning, Oxford Blackwell, Semantics, 1962.
15. Sanskrit Syntax, J.S. Speijer, Motilal Banarasidass, Delhi.
16. An Introduction to Language, Fromkin, V. and R. Rodman, New York etc. Harcourt, Brace Jovenovich College Publishers, 1988, 1992.
17. The Principles of Semantics, Blackwell, Ullmann, Stephen, 1957.
18. Semantic Analysis, Ithaca, N.Y. Ziff, Paul, Cornell University Press, 1960.
19. Linguistics, An Introduction to Language and Communication, Akmaijan, A.R. Demers and R. Hamish, Cambridge Mass, MIT Press, 1979.

COURSE CODE : SLLCH SKT 1208 C 3104

अष्टमपत्रम् : भारतीयदर्शनम् (2)

Paper-VIII : Bhāratīyadarśanam (2)

L	T	P	Credits
3	1	-	4

पूर्णाङ्काः 70

आन्तरिकमूल्याङ्कनाङ्काः 30

समयः 3 होराः (3 Hours)

घटकम्-1: लौगाक्षिभास्करः - अर्थसङ्ग्रहः (आरम्भतः विधिभागपर्यन्तम्)।

14अङ्काः

घटकम्-2: अर्थसङ्ग्रहः : (निषेधभागतः समाप्तिपर्यन्तम्)।

14अङ्काः

घटकम्-3: सदानन्दयोगीन्द्रः - वेदान्तसारः (आरम्भतः अध्यारोपप्रकरणपर्यन्तम्)।

14अङ्काः

घटकम्-4: वेदान्तसारः (अपवादप्रकरणतः समाप्तिपर्यन्तम्)।

14अङ्काः

सर्वघटकानां सम्मिलितः प्रश्नः - 14 अङ्काः

प्रश्नपत्रनिर्माणविधिः

1. प्रश्नपत्रस्य निर्माणं **संस्कृतमाध्यमेन** भवेत्।
2. प्रश्नपत्रे **पञ्च (5)** अनिवार्याः प्रश्नाः भविष्यन्ति। **प्रथमः प्रश्नः संस्कृतमाध्यमेन एव समाधेयः।** अन्ये प्रश्नाः संस्कृत-हिन्दी-आंग्लभाषा-माध्यमेन वा यथेच्छं समाधेयाः।
3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति-
 - I. प्रथमः प्रश्नः - **घटकचतुष्टयगतपाठ्यक्रममाश्रित्य** भवेत्। अस्मिन् प्रश्ने **सप्त (7)** विकल्परहिताः –
संक्षिप्तोत्तरप्रश्नाः प्रदास्यन्ते। (7X2=14अङ्काः)
 - II. द्वितीयः प्रश्नः (प्रथमघटकाश्रितः) – (क) सिद्धान्तरूपं **प्रश्नमेकं** समाधातुं **प्रश्नद्वयं** प्रदास्यते। (6अङ्काः)
(ख) **पंक्तिद्वयं** व्याख्यातुं **पंक्तिचतुष्टयं** प्रदास्यते। (2X4=8अङ्काः)
 - III. तृतीयः प्रश्नः (द्वितीयघटकाश्रितः) (क) सिद्धान्तरूपं **प्रश्नमेकं** समाधातुं **प्रश्नद्वयं** प्रदास्यते। (6अङ्काः)
(ख) **पंक्तिद्वयं** व्याख्यातुं **पंक्तिचतुष्टयं** प्रदास्यते। (2X4=8अङ्काः)
 - IV. चतुर्थः प्रश्नः (तृतीयघटकाश्रितः) -
(क) सिद्धान्तरूपं **प्रश्नमेकं** समाधातुं **प्रश्नद्वयं** प्रदास्यते। (6अङ्काः)
(ख) **कारिकामेकं** व्याख्यातुं **कारिकाद्वयं** प्रदास्यते। (2X4=8अङ्काः)
 - V. पञ्चमः प्रश्नः (चतुर्थघटकाश्रितः) -
(क) सिद्धान्तरूपं **प्रश्नमेकं** समाधातुं **प्रश्नद्वयं** प्रदास्यते। (6अङ्काः)
(ख) **कारिकामेकं** व्याख्यातुं **कारिकाद्वयं** प्रदास्यते। (2X4=8अङ्काः)

अनुशंसितग्रन्थाः

1. अर्थसंग्रह, सम्पा० तथा व्याख्याकार वाचस्पति उपाध्याय, चौखम्बा ओरियण्टलिया।
2. अर्थसंग्रहः, व्याख्याकार दयाशङ्कर शास्त्री, कानपुर।
3. अर्थसंग्रहः, व्याख्याकार सत्यप्रकाश शर्मा, साहित्य भण्डार, मेरठा।
4. Arthasaṅgraha, Eng. Tr. by A.B. Gajendragadkar and R.D. Karmarkar, Motilal Banarsidass, Delhi.
5. Arthasaṅgraha, Eng. Tr. by G. Thibaut, Delhi.
6. वेदान्तसार, व्याख्याकार बदरीनाथ शुक्ल, वाराणसी।
7. वेदान्तसार, सम्पादक तथा व्याख्याकार राममूर्ति शर्मा, दिल्ली।
8. वेदान्तसार, व्याख्याकार गजानन शास्त्री मुसलगाँवकर, वाराणसी।
9. वेदान्तसार, सम्पादक तथा व्याख्याकार डॉ० आद्याप्रसाद मिश्र, अक्षयवट प्रकाशन, इलाहाबाद।
10. Vedāntasāra, Eng. Tr. by M. Hiriyanna.

11. Vedāntasāra, Eng. Tr. by Swami Nikhilananda.
12. Outline of Indian Philosophy, Radhakrishnan.
13. भारतीय दर्शन, बलदेव उपाध्याय।

COURSE CODE : SLLCH SKT 1209 C 3104

नवमपत्रम् : काव्यम् काव्यशास्त्रञ्च

Paper-IX : Kāvyaṁ Kāvyaśāstrañca

L	T	P	Credits
3	1	-	4

पूर्णाङ्काः 70

आन्तरिकमूल्याङ्कनाङ्काः 30

समयः 3 होराः (3 Hours)

घटकम्-1: बाणभट्टः - कादम्बरी (शुकनासोपदेशः)।

14अङ्काः

घटकम्-2: कालिदासः - मेघदूतम् (उत्तरमेघः)।

14अङ्काः

घटकम्-3: विश्वनाथः - साहित्यदर्पणः-

प्रथमः परिच्छेदः। द्वितीयः परिच्छेदः - अभिधानिरूपणम् (कारिका-संख्या 4 पर्यन्तम्)।

14अङ्काः

घटकम्-4: साहित्यदर्पणः -

द्वितीयः परिच्छेदः-लक्षणानिरूपणम् व्यञ्जनानिरूपणञ्च (कारिकाः 5-20)।

14अङ्काः

सर्वघटकानां सम्मिलितः प्रश्नः - 14 अङ्काः

प्रश्नपत्रनिर्माणविधिः

1. प्रश्नपत्रस्य निर्माणं संस्कृतमाध्यमेन भवेत्।
2. प्रश्नपत्रे पञ्च (5) अनिवार्याः प्रश्नाः भविष्यन्ति। प्रथमः प्रश्नः संस्कृतमाध्यमेन एव समाधेयः। अन्ये प्रश्नाः संस्कृत-हिन्दी-आंग्लभाषा-माध्यमेन वा यथेच्छं समाधेयाः।
3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति-
 - I. प्रथमः प्रश्नः - घटकचतुष्टयगतपाठ्यक्रममाश्रित्य भवेत्। अस्मिन् प्रश्ने सप्त (7) विकल्परहिताः संक्षिप्तोत्तरप्रश्नाः प्रदास्यन्ते। (7X2=14अङ्काः)
 - II. द्वितीयः प्रश्नः (प्रथमघटकाश्रितः) - (क) सप्रसङ्गं काव्यसौष्टवनिर्देशपूर्वकं गद्यांशमेकमनुदितुं गद्यांशद्वयं प्रदास्यते। (6अङ्काः)
 - (ख) बाणभट्टस्य रचनावैशिष्ट्यसंबन्धि-टिप्पणीलेखनार्थं विषयद्वयं प्रदास्यते। (8अङ्काः)
 - III. तृतीयः प्रश्नः (द्वितीयघटकाश्रितः) - सप्रसङ्गं श्लोकद्वयं व्याख्यातुं श्लोकचतुष्टयं प्रदास्यते। (2X7=14अङ्काः)
 - IV. चतुर्थः प्रश्नः (तृतीयचतुर्थघटकाश्रितः) - सप्रसङ्गं कारिकाद्वयं व्याख्यातुं कारिकाचतुष्टयं प्रदास्यते। (2X7=14अङ्काः)
 - V. पञ्चमः प्रश्नः (तृतीयचतुर्थघटकाश्रितः) - सैद्धान्तिक टिप्पणीद्वयं-लेखनार्थं विषय-चतुष्टयं प्रदास्यन्ते। (2X7=14अङ्काः)

अनुशंसितग्रन्थाः

1. कादम्बरी, शुकनासोपदेशः, सम्पा० आचार्यः रामनाथः शर्मा, राजेन्द्रकुमारः शास्त्री च, साहित्यभण्डारम्, मेरठनगरम्, पञ्चमसंस्करणम्, 2001
2. कादम्बरी, शुकनासोपदेशः, सम्पाकार आचार्यः कपिलदेव गिरि, वाराणसी।
3. कादम्बरी : एक सांस्कृतिक अध्ययन, डॉ० वासुदेवशरण अग्रवाल।
4. बाणभट्ट का साहित्यिक अनुशीलन, अमरनाथ पाण्डेय।
5. साहित्यदर्पण, सम्पादक पी०वी० काणे, मोतीलाल बनारसीदास, दिल्ली।

6. साहित्यदर्पण, व्याख्याकार कृष्णमोहन शास्त्री।
7. साहित्यदर्पण, सम्पादक शालिग्राम शास्त्री, मोतीलाल बनारसीदास, दिल्ली।
8. साहित्यदर्पण, व्याख्याकार डॉ० श्रीनिवास शास्त्री, साहित्य भण्डार, सुभाष बाजार, मेरठ।
9. The Meghadūta of Kalidāsa, M.R. Kale, Motilal Banarsidass, Delhi-2015.

COURSE CODE : SLLCH SKT 1210 C 3104

दशमपत्रम् : धर्मशास्त्रम् (2)

Paper-X : Dharmaśāstram (2)

L	T	P	Credits
3	1	-	4

पूर्णाङ्काः: 70

आन्तरिकमूल्याङ्कनाङ्काः: 30

समयः 3 होराः (3 Hours)

- घटकम्-1:** श्रीमद्भगवद्गीता, एकादशोऽध्यायः द्वादशोऽध्यायश्च। 14अङ्काः
- घटकम्-2:** महर्षि-दयानन्दः - सत्यार्थप्रकाशः, ईश्वरनामविषयः प्रथमः समुल्लासः। 14अङ्काः
- घटकम्-3:** महर्षि-दयानन्दः संस्कारविधिः, सामान्यप्रकरणम्। 14अङ्काः
- घटकम्-4:** महर्षि-दयानन्दः - संस्कारविधिः, उपनयनं वेदारम्भसंस्कारश्च। 14अङ्काः

सर्वघटकानां सम्मिलितः प्रश्नः - 14 अङ्काः

प्रश्नपत्रनिर्माणविधिः

1. प्रश्नपत्रस्य निर्माणं संस्कृतमाध्यमेन भवेत्।
2. प्रश्नपत्रे पञ्च (5) अनिवार्याः प्रश्नाः भविष्यन्ति। प्रथमः प्रश्नः संस्कृतमाध्यमेन एव समाधेयः। अन्ये प्रश्नाः संस्कृत-हिन्दी-आंग्लभाषा-माध्यमेन वा यथेच्छं समाधेयाः।
3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति-
 - I. प्रथमः प्रश्नः (घटकचतुष्टयगतपाठ्यक्रमाश्रितः) - सप्त (7) विकल्परहिताः संक्षिप्तोत्तरप्रश्नाः प्रदास्यन्ते।
(7X2=14अङ्काः)
 - II. द्वितीयः प्रश्नः (प्रथमघटकाश्रितः) - श्लोकद्वयं विस्तेर्य भावनिर्देशपूर्वकं व्याख्यातुं श्लोकचतुष्टयं प्रदास्यते।
(14अङ्काः)
 - III. तृतीयः प्रश्नः (द्वितीयघटकाश्रितः) - सप्तनिर्वचनानि लेखितुं चतुर्दश-निर्वचनानि प्रदास्यन्ते।
(7X2=14अङ्काः)
 - IV. चतुर्थः प्रश्नः (तृतीयघटकाश्रितः) - (क) विनियोजननिर्देशपूर्वकं मन्त्रद्वयस्य लेखनार्थं पूरणार्थं वा मन्त्रचतुष्टयं प्रदास्यन्ते।
(4X2=8अङ्काः)
(ख) संस्कारसंबन्धि टिप्पणीद्वयं लेखनार्थं विषयचतुष्टयं प्रदास्यते।
(2X3=6अङ्काः)
 - V. पञ्चमः प्रश्नः (चतुर्थघटकाश्रितः) - (क) विनियोजननिर्देशपूर्वकं मन्त्रद्वयस्य लेखनार्थं पूरणार्थं वा मन्त्रचतुष्टयं प्रदास्यन्ते।
(2X4=8अङ्काः)
(ख) यज्ञसंबन्धि टिप्पणीद्वयं लेखनार्थं विषयचतुष्टयं प्रदास्यते।
(2X3=6अङ्काः)

अनुशंसितग्रन्थाः

1. श्रीमत्स्वामी-दयानन्दसरस्वती, सत्यार्थप्रकाशः, सं० युधिष्ठिर मीमांसक, रामलाल कपूर ट्रस्ट, रेवली, सोनीपत, 2007
2. महर्षिदयानन्दसरस्वतीस्वामिविरचितः, सत्यार्थप्रकाशः, शोधकर्ता, समीक्षक, सम्पादक, भाष्यकार डॉ० सुरेन्द्रकुमार, सत्यधर्म प्रकाशन, प्राप्तिस्थान - विजयकुमार गोविन्दराम हासानन्द, 4408, नई सड़क, दिल्ली-6, 2014
3. श्रीमत्स्वामी-दयानन्द सरस्वती, सत्यार्थप्रकाश, वैदिक पुस्तकालय, दयानन्द आश्रम, केसरगंज, अजमेर -

4. श्रीमत्स्वामी-दयानन्दसरस्वती, संस्कारविधि, वैदिक पुस्तकालय, दयानन्द आश्रम, केसरगंज, अजमेर-305001, 2017
5. श्रीमद्भगवद्गीता, संपा० वासुदेवलक्ष्मण शास्त्री पणशीकर, आठ भाष्यों व टीकाओं सहित, मुंशीराम मनोहरलाल पब्लिशर्स प्रा० लि०, नई दिल्ली-110055, 1966
6. श्रीमद्भगवद्गीता, गीता प्रेस, गोरखपुरा

**एम० ए० संस्कृतम्, द्वितीयं सत्रम्
(2019-2020 शैक्षिकसत्रतः)**

**M. A. SANSKRIT, SECOND SEMESTER
(w.e.f. Academic Session : 2019-2020)**

COURSE CODE : SLLCH SKT 1201 V 0002

VIVA-VOCE (मौखिकी परीक्षा)

पूर्णाङ्काः (Maximum Marks): 50

Credits: 2

टिप्पणी : एम०ए० (संस्कृतम्)-द्वितीयसत्रस्य पाठ्यक्रमसमाप्तेः अनन्तरं प्रथमद्वितीयसत्रयोः अधीतं पाठ्यक्रमम् आश्रित्य छात्राणां संस्कृतमाध्यमेन मौखिकी परीक्षा आयोजयिष्यते।

Note:- Viva-Voce of the students, based on the syllabus covered in their 1st and 2nd Semester courses, will be conducted through **Sanskrit medium** after the completion of the syllabus of M.A. Sanskrit, Second Semester.

CHOICE BASED CREDIT SYSTEM

Generic Elective Course

COURSE CODE : SLLCH SKT 1101 GE 3003

प्राचीनभारतीयसंस्कृतिः, दर्शनं भाषाविज्ञानञ्च (1)

Prācīnabhāratīyasaṁskṛtiḥ, Darśanaṁ Bhāṣāvijñānañca (1)

माध्यमः – संस्कृत/हिन्दी/आंग्लभाषा

Medium – Sanskrit/Hindi/English

L	T	P	Credits
3	1	-	4

अङ्काः 70

आन्तरिकमूल्याङ्कनाङ्काः 30

समयः 3 होराः

घटकम्-1: (क) यजुर्वेदः (34. 1-6)-शिवसंकल्पमन्त्राः। (ख) तैत्तिरीयोपनिषद् - शिक्षावल्ली (अनुशासनोपनिषद्)।

14अङ्काः

घटकम्-2: भर्तृहरिः- नीतिशतकम् : 1-50 श्लोकाः।

14अङ्काः

घटकम्-3: भगवद्गीता - तृतीयाध्यायः, (कर्मयोगः) : व्याख्या आलोचनात्मकप्रश्नः च।

14अङ्काः

घटकम्-4: सामान्यभाषाविज्ञानम्-

14अङ्काः

(क) वर्णमाला, वर्णानाम् उच्चारणस्थानानि प्रयत्नाश्च,

(ग) भाषाविज्ञानस्य सामान्यपरिचयः, भाषापरिवर्तनस्य कारणानि, अर्थपरिवर्तनस्य दिशःकारणानि च।

सर्वघटकानां सम्मिलितः प्रश्नः - **14 अङ्काः**

प्रश्नपत्रनिर्माणविधि:

1. प्रश्नपत्रस्य निर्माणं संस्कृतभाषायामांग्लभाषायाञ्च भविष्यति। प्रश्नपत्रं यथेच्छं संस्कृत/हिन्दी/आंग्लभाषामाध्यमेन समाधेयः।
2. प्रश्नपत्रे पञ्च (5) प्रश्नाः प्रदास्यन्ते।
3. प्रश्नानाम् अङ्कानां च विभाजनम् अधोलिखितरूपेण भविष्यति:-
 - I. घटकचतुष्टयगतपाठ्यक्रममाश्रित्य सप्त विकल्परहिताः लघूत्तरप्रश्नाः प्रदास्यन्ते। (7X2=14अङ्काः)
 - II. द्वितीयः प्रश्नः – (प्रथमघटकाश्रितः) क- एकं मन्त्रं विस्तरेण व्याख्यातुं मन्त्रद्वयं प्रदास्यते। (7अङ्काः)
ख- एकं पाठांशं विस्तरेण व्याख्यातुं पाठांशद्वयं प्रदास्यते। (7अङ्काः)
 - III. तृतीयः प्रश्नः – (द्वितीयघटकाश्रितः) (क)- विषयद्वयं दत्त्वा एकस्योपरि विस्तृता टिप्पणी लेखनीया। (6अङ्काः)
(ख)- टिप्पणीद्वयं लेखनार्थं विषयचतुष्टयं प्रदास्यते। (2X4=8अङ्काः)
 - IV. चतुर्थः प्रश्नः – (तृतीयघटकाश्रितः) (क)- श्लोकद्वयं दत्त्वा एकस्य श्लोकस्य विस्तृता व्याख्या प्रक्ष्यते। 6अङ्काः)
(ख)- श्लोकद्वयस्य तत्त्वनिरूपणार्थं श्लोकचतुष्टयं प्रदास्यते। (2X4=8अङ्काः)
 - V. पञ्चमः प्रश्नः – (चतुर्थघटकाश्रितः) (क) टिप्पणीद्वयलेखनार्थं विषयचतुष्टयं प्रदास्यते। (2X4=8अङ्काः)
(ख) एकं प्रश्नं समाधातुं प्रश्नद्वयं प्रदास्यते। (6अङ्काः)

अनुशंसितग्रन्थाः -

1. उवट-महीधर, शुक्लयजुर्वेदभाष्य, मोतीलाल बनारसीदास, दिल्ली।
2. स्वामी दयानन्द सरस्वती, यजुर्वेदभाष्य, सम्पा० ब्रह्मदत्त जिज्ञासु, रामलाल कपूर ट्रस्ट, सोनीपत (हरियाणा)।
3. तैत्तिरीयोपनिषद्, हिन्दी व्याख्याकार - स्वामी प्रखर प्रज्ञानन्द सरस्वती, काशी।
4. भर्तृहरि, नीतिशतक, सम्पादक एवं हिन्दी व्याख्याकार - जनार्दन शास्त्री पाण्डेय, मोतीलाल बनारसीदास, दिल्ली।
5. नीतिशतकम्, 'नीतिपथ' हिन्दी व्याख्याकार - राजेश्वर शास्त्री मुसलगाँवकर, चौखम्भा, वाराणसी।
6. संक्षिप्त-नीतिशतकम्, संपा० डॉ० सुरेन्द्र, देवेश पब्लिकेशन्स, नई दिल्ली, 2008
7. श्रीमद्भगवद्गीता (हिन्दी अनुवाद सहित), गीता प्रेस, गोरखपुर।
8. श्रीकृष्ण त्रिपाठी, श्रीमद्भगवद्गीता (द्वितीय, तृतीय एवं चतुर्थ अध्याय)।
9. Radhakrishnan, Gītā.
10. देवीदत्त शर्मा, भाषिकी और संस्कृत भाषा, हरियाणा साहित्य अकादमी, चण्डीगढ़, 1990
11. कपिलदेव द्विवेदी, भाषा-विज्ञान एवं भाषा-शास्त्र, विश्वविद्यालय प्रकाशन, चौक, वाराणसी।
12. कर्णसिंह, भाषाविज्ञान, साहित्य भण्डार, मेरठ।
13. Burrow, T. : The Sanskrit Language.
14. Gune, P.D. : An Introduction to Comparative Philology, Oriental Book House, Poona, 1958.
15. Taittiriya Upanishad, Eng. Translation and Commentary by Swami Muni Narayan Prasad. D.K. Print world (P) Ltd, New-Delhi-1983.

CENTRAL UNIVERSITY OF HARYANA

(Established Vide Act No. 25 (2009) of Parliament)

Jant-Pali, Distt. : Mahendragarh – 123031 (Haryana)

Department of Yoga

CUH/Yog/19/02

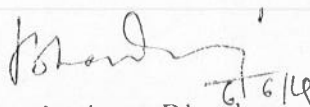
Dated : 06/06/2019

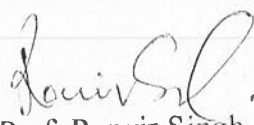
Sub - Meeting of Board of Studies.

It is submitted that the first Meeting of the Board of Studies In Yoga held on 06/06/2019. Following members attended the same –

- 1 Prof. Ishwar Bhardwaj
Professor, Dept. of Yoga &
Dean, Faculty of Medical Science and Health
Gurukul Kangri University, Haridwar, UK
- 2 Prof. Ranvir Singh
Coordinator, Dept. of Yoga
Central University of Haryana
Jant-Pali, Mahendergarh - 123031

One outside member Prof. Ganesh Shankar Giri, Professor & HOD, Dept of Yogic Sciences, Dr. Hari Singh Gaur University, Sagar, MP was set to attend the meeting but due to heat stroke at the eleventh hour could not attend. Syllabus of Semester-I & II of M.A. Yoga was finalized and it is to be implemented w.e.f. the current session. The Final draft of soft copy will be circulated to the outside experts and shall be finalized accordingly.


Prof. Ishwar Bhardwaj
Outside Expert

 6/6/2019
Prof. Ranvir Singh
Coordinator

CENTRAL UNIVERSITY OF HARYANA
MAHENDERGARH
(Established vide Central Universities Act 2009)
NAAC Accredited 'A' Grade University



SCHEME, SYLLABUS AND COURSES OF READING
Offered by the Department of Yoga for
M. A. in YOGA Sciences
SEMESTERS: I-IV
(Proposed w.e.f. the Academic Session: 2019-2021)

Semester – I	Examination: December,	2019
Semester – II	Examination: May,	2020
Semester – III	Examination: December,	2020
Semester – IV	Examination: May,	2021

(Approved in the Meeting of BOS Held on June 06, 2019.)



**Credit Matrix for M.A. Yoga
w.e.f. 2019-2020**

Semesters	Core Course (CC)	Discipline Centric Elective Courses (DCEC)	Interdisciplinary/ Generic Elective Course (GEC)	Total
I	26	-	-	26
II	16	5	4	25
III	16	5	4	25
IV	21	5	-	26
Total	69	15	8	102

Instructions for the Students:

Course Type

Core Course (CC): There are core courses in every semester. These courses are to be compulsorily studied by a student as core courses to complete the requirement of this discipline of study.

Discipline Centric Elective Courses (DCEC): These are Elective courses and can be chosen from a pool of papers in all Semesters. These will be supportive to gain in depth understanding in concerned field of Yoga and are mandatory as per course curriculum.

Generic Elective Course (GEC): Generic Elective Course may be from an unrelated discipline. It is interdisciplinary/open elective as per course curriculum. Available/offered by the departments included in the School or can be taken from the GEC Course offered by the Department of Yoga.

Introduction:

Yoga is an ancient Indian scientific system and is evolved by Vedic Rishis for holistic growth of body, mind and spirit. It has potential for prevention of physiological and psychosomatic disorders and promotion of inclusive health. The eclectic approach of Yoga brings harmony in the individual and social life. It brings suitable changes in the behavioral pattern and attitude thereby helps to improve the inter-personal relationship at home and also in the society. Therapeutic benefits of Yoga have also been revealed by many scientific researches carried out all over the world. Today, Yoga has become very popular and has gained essential, indispensable and even imperative space in the lives of individual dignitaries.

Objectives of the Course:

- 1) The course will provide deeper insight into the curriculum of Yogic Sciences along with the therapeutic applications of Yoga and alternative therapies.
- 2) At the Master level it is also intended that students should get familiar with the original texts.

- 3) Promoting Positive Health in the Students through Yoga and enabling and imparting skill in them to practice and apply Yogic practices for Health to general public and teach Yoga for Total personality development and spiritual evolution.
- 4) Invoking and inculcating inquisitive, scientific temper in students regarding the Traditional Indian Sciences specially Yoga and Spirituality.
- 5) A research attitude and orientation will also be inculcated into the students so that they further become able to undertake advance and theoretical and applied researches in the field of Yoga and Alternative Therapies.

Structure of Program:

Semester - I

Course	Title of the Paper	L	T	P	C	Marks	Teaching Hours
SLLCH YOG 1101 C 4105	Fundamentals and Foundation of Yoga	4	1	0	05	30+70=100	60+15
SLLCH YOG 1102 C 4105	Principles, Practices and Essentials of Haṭha-Yoga	4	1	0	05	30+70=100	60+15
SLLCH YOG 1103 C 0055	Yoga Practical - 1		0	6	06	30+70=100	60+15
SLLCH YOG 1104 C 4105	Human Anatomy Physiology and Yogic Exercises -1	4	1	0	05	30+70=100	60+15
SLLCH YOG 1105 C 4105	Eminent Ancient and Medieval Yogis of India	4	1	0	05	30+70=100	60+15
Total					26	500	

Semester - II

Course	Title of the Paper	L	T	P	C	Marks	Teaching Hours
SLLCH YOG 1206 C 4105	Pātañjala-Yogasūtra	4	1	0	05	30+70=100	60+15
SLLCH YOG 1207 C 4105	Human Anatomy Physiology and Yogic Exercises - 2	4	1	0	05	30+70=100	60+15
SLLCH YOG 1208 C 0066	Yoga Practical - 2	0	0	6	06	30+70=100	60+15
SLLCH YOG 1209C 4105	Eminent Modern Yogis of India	4	1	0	05	30+70=100	60+15
SLLCH YOG 1101 GE 3104	Fundamentals of Yoga	3	1	0	04	30+70=100	30+10
Total					25	500	

Semester – III

Course	Title of the Paper	L	T	P	C	Marks	Teaching Hours
SLLCH YOG 1310 C 4105	Indian Philosophy	4	1	0	05	30+70=100	60+15
SLLCH YOG 1311 C 4105	Holistic Health and Yoga Therapy	4	1	0	05	30+70=100	60+15
SLLCH YOG 1312 C 0055	Yoga Practical - 3	0	0	6	06	30+70=100	60+15
SLLCH YOG 1313 C 4105	Teaching Methods in Yoga through power Point Presentation	4	1	0	05	30+70=100	60+15
SLLCH YOG 1102 GE 3104	Yoga and Holistic Health	3	1	0	04	30+70=100	30+10
Total					25	500	

Semester - IV

Course	Title of the Paper	L	T	P	C	Marks	Teaching Hours
SLLCH YOG 1414 C 4105	Āyurveda, Svasthavṛtta and Diet	4	1	0	05	30+70=100	60+15
SLLCH YOG 1415 C 4105	Applied Psychology and Yoga	4	1	0	05	30+70=100	60+15
SLLCH YOG 1416 C 0055	Yoga Practical -4 and Naturopathy	0	0	6	06	30+70=100	60+15
SLLCH YOG 1417 C 4105	Principles of Naturopathy and Natural Dietetics	4	1	0	05	30+70=100	60+15
SLLCH YOG 1418 DCEC 3104	Research Methodology and Statistics in Yoga	4	1	0	05	30+70=100	60+15
SLLCH YOG 1419 DCEC 3104	Project/Seminar/Workshop on Yoga	4	1	0	05	30+70=100	60=15
Total					26	400	

Scheme of Examination:

Seventy five percent (75%) attendances in theory and practical classes respectively will be necessary for a candidate to appear in the Internal Assessment and End-Semester examination.

The evaluation will be based on the following scheme:

- (a) Internal Assessment : 30 Marks
(b) End Semester Examination : 70 Marks

Scheme of Evaluation:

(A) Internal Assessment:

(a) Theory:

- (i) Evaluation of assignment, presentation etc. : 15 Marks
(ii) Class Test : 10 Marks
(iii) Attendance : 05 Marks

The marks of attendance shall be awarded as follows:

- | | |
|-------------------------|------------|
| (i) 75% and below | : 00 Mark |
| (ii) 75% and up to 80% | : 01 Mark |
| (iii) 80% and up to 85% | : 02 Marks |
| (iv) 85% and up to 90% | : 03 Marks |
| (v) 90% and up to 95% | : 04 Marks |
| (vi) 95% | : 05 Marks |

(b) Practical:

The Evaluation of practical shall be awarded as follows:

- | | |
|-----------------------------------|------------|
| (i) Yogic practices and Viva-voce | : 15 Marks |
| (ii) Attendance | : 05 Marks |

The marks of attendance shall be awarded as follows:

- | | |
|-------------------------|------------|
| (i) 75% and below | : 00 Mark |
| (ii) 75% and up to 80% | : 01 Mark |
| (iii) 80% and up to 85% | : 02 Marks |
| (iv) 85% and up to 90% | : 03 Marks |
| (v) 90% and up to 95% | : 04 Marks |
| (vi) 95% | : 05 Marks |

(B) End Semester Examination for Practical:

It will consist of 60 marks as follows:

- | | |
|--|------------|
| (i) Yogic practices and Practical notebook | : 50 Marks |
| (ii) Viva-voce | : 10 Marks |

(C) Evaluation of Projects:

It will be based on periodic assessment of the progress of the project and End semester examination as follow:

- | | |
|--|------------|
| (i) First periodic assessment of the progress after 08 weeks | : 20 Marks |
| (ii) Second periodic assessment of after 04 weeks | : 20 Marks |
| (iii) End semester examination will consist of: | |
| (a) Evaluation of project report | : 50 Marks |
| (b) Viva-Voce of the project report | : 10 Marks |

(D) Evaluation of Seminars/ Workshops:

- | | |
|--|------------|
| (i) Documentation for the Seminars/ Workshops | : 20 Marks |
| (ii) First presentation of the Seminars/ Workshops | : 20 Marks |
| (iii) End semester examination will consist of: | |
| (a) Presentation the Seminars/ Workshops | : 50 Marks |
| (b) Defense of the Presentation | : 10 Marks |

प्रथम सत्र - First Semester

SLCH YOG 1101 C 4105 - योग के आधारभूत मौलिक तत्व-Fundamentals of Yoga

Unit-I परिचय - Introduction

- 1) योग का अर्थ एवं परिभाषाएँ, योग का स्वरूप, योग का उद्देश्य - Meaning, Definitions, Form and Objectives of Yoga□
- 2) योग की उत्पत्ति, योग का इतिहास और विकास - Origin, Development and Historical Background of Yoga.
- 3) योग से संबन्धित भ्रामक धारणाएँ एवं उनके समाधान - Misconceptions about Yoga and their Solutions.
- 4) नाडी और प्राण की अवधारणाएँ, कुण्डलिनी शक्ति एवं षट्चक्र का परिचय - Conceptions of Nāḍī, and Prāṇa, Introduction to Kuṇḍalinī, and Ṣaṭcakra.

Unit-II विभिन्न ग्रन्थों एवं परम्पराओं में योग - Yoga in Different Texts and Traditions

- 1) वेदों, उपनिषदों व गीता में योग का स्वरूप - Form of Yoga in Vedas, Upaniṣads and Gītā.
- 2) न्याय, वैशेषिक, सांख्य, मीमांसा, वेदान्त बौद्ध और जैन दर्शनों में योग का स्वरूप - Form of Yoga in Nyāya, Vaiśeṣika, Sāṅkhya, Mīmāṃsā and Vedānta Schools of Indian Philosophy.
- 3) आयुर्वेद, योगवाशिष्ठ एवं तंत्र में योग का स्वरूप - Form of Yoga in Āyurveda, Yoga-Vāsiṣṭha and Tantras.

Unit-III योग के विभिन्न प्रकार -1 (संक्षिप्त परिचय) - Different Types of Yoga I : (Brief Introduction)

- 1) हठयोग -Haṭha-yoga, 2) राजयोग - Rāja-yoga, 3) मन्त्रयोग - Mantra-yoga, 4) लययोग - Laya-yoga,

Unit-IV योग के विभिन्न प्रकार 2: (संक्षिप्त परिचय) - Different Types of Yoga 2 : (Brief Introduction)

- 1) कर्मयोग - Karma-yoga, 2) ज्ञानयोग - Jñāna-yoga, 3) भक्तियोग - Bhakti-yoga

Unit-V योगाभ्यास की अनिवार्यताएँ - Essentials for Yoga Practice:

- 1) योगाभ्यास के नियम एवम् अनुशासन - Rules and Disciplines in Yogic Practices
- 2) योगाभ्यास का स्थान एवं समय - Place and Timing of Yogic Practices
- 3) योगाभ्यासी की भोजन सूची एवं सारिणी - List and Schedule of Diet of Yoga Practitioner
- 4) योगाभ्यास के मार्ग में बाधाएँ - Obstacles in the Path of Yoga Practice
- 5) योगाभ्यास का अनुक्रम - Sequence of Yogic Practices

परीक्षक के लिए निर्देश : इस प्रश्न-पत्र में तीन खण्ड होंगे- अ, ब और स। “खण्ड अ” में पाँच अति लघु-उत्तरीय प्रश्न होंगे, जिनमें से प्रत्येक दो अंक का होगा। ये सभी प्रश्न अनिवार्य होंगे। “खण्ड ब” में दस लघु-उत्तरीय प्रश्न होंगे, जिनमें से पाँच प्रश्न करने होंगे तथा प्रत्येक चार अंकों का होगा। “खण्ड स” में आठ दीर्घ-उत्तरीय प्रश्न होंगे, जिनमें से चार प्रश्न करने होंगे तथा प्रत्येक दस अंकों का होगा। प्रश्न-पत्र सम्पूर्ण पाठ्यक्रम को ध्यान में रखकर बनाया जाएगा।

Instruction for Examiner: There will be three parts in this Question Paper - अ, ब and स. In first part अ there will be five very-short-answered compulsory questions carrying two marks each. In part ब there will be ten short-answered questions carrying four marks each and are to be attempted any five. The last part स will consist of eight long-answered questions carrying ten marks each and are to be attempted any four. Question paper will be spread to the whole syllabus prescribed for this paper.

आवश्यक पठनीय - Essential Readings:

- 1) स्वामी विज्ञानानन्द सरस्वती, योग-विज्ञान, योग निकेतन ट्रस्ट, ऋषिकेश, 1998
- 2) राजकुमारी पाण्डेय, भारतीय योगपरम्परा के विविध आयाम, राधा प्रकाशन, नई दिल्ली, 2008
- 3) स्वामी विवेकानन्द, ज्ञान-भक्ति-कर्म-योग और राजयोग, अद्वैत आश्रम, कलकत्ता - 2000
- 4) कामाख्या कुमार, योग-महाविज्ञान, Standard Publisher, New Delhi
- 5) कल्याण (योगाङ्क), गीता प्रेस गोरखपुर, 2002
- 6) कल्याण (योग तत्त्वाङ्क), गीता प्रेस गोरखपुर, 1991
- 7) डॉ० ईश्वर भारद्वाज, औपनिषदिक अध्यात्म विज्ञान, सत्यम् पब्लिकेशन्स, उत्तम नगर, नई दिल्ली -

सन्दर्भ ग्रन्थ - Suggested Readings:

1. योग-विज्ञानम्, आचार्य बालकृष्ण, पतञ्जलि योग-पीठ, हरिद्वार
2. वेदों में योग विद्या, स्वामी दिव्यानन्द
3. भारतीय दर्शन, आचार्य बलदेव उपाध्याय
4. भारत के महान् योगी, विश्वनाथ मुखर्जी
5. सन्त-चरित, स्वामी शिवानन्द
6. The Yoga Tradition, Motilal Banarsidass
7. K.S. Joshi - Yoga in Daily Life, Orient Paper Back Publication, New Delhi, 1985.
8. S.P. Singh - History of Yoga - PHISPC, Center for Studies of Civilization, Delhi, 1st Edn. - 2010
9. S. P. Singh and Yogi Mukesh - Foundation of Yoga, Standard Publishers, New Delhi - 2010

SLLCY YOG 1102 C 4105 – हठयोग के सिद्धान्त, अभ्यास एवम् अनिवार्यताएँ -

Principles, Practices and Essentials of Haṭhayoga

(हठयोगप्रदीपिका व घेरण्डसंहिता पर आधृत- Based on Haṭhayogapradīpikā and Gheraṇḍasamhitā)

Unit-I परिचय - Introduction:

1. हठयोग की परिभाषा एवम् उद्देश्य - Haṭhayoga, its definition and objectives
2. हठयोग की उत्पत्ति एवं परम्परा - Origin and Tradition of Haṭhayoga
3. हठाभ्यास-हेतु उचित स्थान, वातावरण, ऋतु एवं काल का महत्त्व - Importance of proper Place, Environment, Season and Time for Haṭha practice
4. हठाभ्यास-हेतु साधक व बाधक तत्त्व - Aids and Obstructions to Haṭha practice

5. हठाभ्यास-हेतु निषिद्ध एवं संस्तुत आहार - Prohibited and Recommended Food for Haṭha practice.

Unit-II अधोलिखित का अर्थ, उद्देश्य, विधि, लाभ एवं सावधानी - Meaning, Objectives, Techniques, Benefits and Cautions of the following:

1. षट्कर्म - Ṣaṭkarmas

Unit-III अधोलिखित का अर्थ, उद्देश्य, विधि, लाभ एवं सावधानी - Meaning, Objectives, Techniques, Benefits and Cautions of the following:

1. आसन - Āsanas

Unit-IV अधोलिखित का अर्थ, उद्देश्य, विधि, लाभ एवं सावधानी - Meaning, Objectives, Techniques, Benefits and Cautions of the following:

1. प्राणायाम - Prāṇāyāma, 2. मुद्रा - Mudrā, व 3. बन्ध - Bandha

Unit-V आध्यात्मिक ऊर्जा - Spiritual Energy:

1. प्रत्याहार - Pratyāhāra, 2. ध्यान - Dhyāna, 3. समाधि - Samādhi, 4. नादानुसन्धान - Nādānusandhāna, 5. चक्र - Cakras, 6. नाड़ी - Nāḍī, 7. पञ्चकोश - Pañcakośa, 8. कुण्डलिनी शक्ति - Kuṇḍalinī Śakti, कुण्डलिनी शक्ति के जागरण की विधि - Technique of awakening Kuṇḍalinī Śakti

परीक्षक के लिए निर्देश: इस प्रश्न-पत्र में तीन खण्ड होंगे- अ, ब और स। “खण्ड अ” में पाँच अति लघु-उत्तरीय प्रश्न होंगे, जिनमें से प्रत्येक दो अंक का होगा। सभी प्रश्न अनिवार्य होंगे। “खण्ड ब” में दस लघु-उत्तरीय प्रश्न होंगे, जिनमें से पाँच प्रश्न करने होंगे तथा प्रत्येक चार अंकों का होगा। “खण्ड स” में आठ दीर्घ-उत्तरीय प्रश्न होंगे, जिनमें से चार प्रश्न करने होंगे तथा प्रत्येक दस अंकों का होगा। प्रश्न-पत्र सम्पूर्ण पाठ्यक्रम को ध्यान में रखकर बनाया जाएगा।

Instruction for Examiner: There will be three parts in this Question Paper - अ, ब and स. In first part अ there will be five very-short-answered compulsory questions carrying two marks each. In part ब there will be ten short-answered questions carrying four marks each and are to be attempted any five. The last part स will consist of eight long-answered questions carrying ten marks each and are to be attempted any four. Question paper will be spread to the whole syllabus prescribed for this paper.

आवश्यक पठनीय - Essential Readings:

- 1) घेरण्ड-संहिता, स्वामी निरञ्जनानन्द, योग भारती, मुंगेर, बिहार - 1997
- 2) हठ-योग-प्रदीपिका, स्वामी दिगम्बर जी व रघुनाथ शास्त्री, कैवल्यधाम, लोनावला, पूना -2006
- 3) घेरण्ड-संहिता, स्वामी दिगम्बर जी व एम.एल. घरोटे, कैवल्यधाम, लोनावला, पूना -1978
- 4) हठ-योग-प्रदीपिका, स्वामी मुक्तिबोधानन्द सरस्वती, योग पब्लिकेशन्स ट्रस्ट, मुंगेर, बिहार-2000
- 5) स्वामी सत्यानन्द सरस्वती, आसन-प्राणायाम-मुद्रा-बन्ध, योग पब्लिकेशन्स ट्रस्ट, मुंगेर, बिहार-2006
- 6) स्वामी कुवलयानन्द व एस.ए. शुक्ल, गोरक्ष-षट्कर्म, कैवल्यधाम, लोनावला, पूना -2006

सन्दर्भ ग्रंथ- Suggested Readings:

- 1) B.K.S. Iyengar - Light on Yoga, Harper Collins Publisher, New Delhi, 2012
- 2) B.K.S. Iyengar - Light on Pranayama, Harper Collins Publisher, New Delhi, 2012
- 3) M.L.Gharote - Hatha Ratnavali, Kaivalyadham SMYM Samiti, Lonavala, 2009
- 5) M.L.Gharote - Siddhasiddhant Paddhati, Kaivalyadham SMYM Samiti, Lonavala, 2005

SLLCH YOG 1103 C 0066 – यौगिक अभ्यास - Yoga Practical

यौगिक क्रियाओं का क्रमिक अभ्यास - Sequence of Yoga Practices

1. **षट्कर्म - Ṣaṭkarmas:** गजकरणी (कुञ्जल), जलनेति, सूत्रनेति, रबरनेति, अग्निसार, वातक्रम-कपालभाति – Gajakaraṇaḥ, (Kuñjala), Jalaneti, Sūtraneti, Rabarneti, Agnisāra, Vātakrama-Kapālabhāti
2. **सूक्ष्म-व्यायाम - Subtle Exercise:** स्वामी धीरेन्द्र ब्रह्मचारी कृत 'सूक्ष्म व्यायाम' से प्रथम बीस क्रियाएँ – First twenty exercises from the Book - 'Sūkṣma Vyāyāma' of Swami Dhirendra Brahmachari.
3. **सूर्य-नमस्कार (संबद्ध मन्त्रोच्चारण-पूर्वक) - Sūrya-Namaskāra** (Along recitation of concerned mantras)
4. **आसन – Āsanas:** उत्तानपादासन, भुजंगासन, शलभासन, नौकासन, विपरीत-नौकासन या नाभ्यासन, मकरासन, धनुरासन, सिद्धासन, स्वस्तिकासन, पद्मासन, उत्थित-पद्मासन, वक्रासन, अर्धमत्स्येन्द्रासन, गोमुखासन, वज्रासन, सुप्तवज्रासन, कूर्मासन, उत्तानकूर्मासन, शांकासन (गुरुप्रणामासन), दण्डासन, सिंहासन, भद्रासन, मार्जार्यासन, व्याघ्रासन, कागासन, ताड़ासन, कटिचक्रासन, पार्श्वचक्रासन, त्रिकोणासन, कोणासन, ऊर्ध्वहस्तोत्तानासन, उत्कटासन, पादहस्तासन, नटराजासन व शवासन - Uttānapādāsana, Bhujangāsana, Śalabhāsana, Naukāsana, Viparṇṇa-Naukāsana or Nābhyāsana, Makarāsana, Dhanurāsana, Siddhāsana, Svastikāsana, Padmāsana, Utthita-Padmāsana, Vakraśana, Ardhamatsyendrāsana, Gomukhāsana, Vajrāsana, Supta-Vajrāsana, Kurmāsana, Uttāna-Kurmāsana, Śaśāṅkāsana (Gurupraṇāmāsana), Daṇḍāsana, Siṅhāsana, Bhadrāsana, Mārjāryāsana, Vyāghrāsana, Kāgāsana, Tāḍāsana, Kaṭicakrāsana, Pārśva-cakrāsana, Trikoṇāsana, Koṇāsana, Ūrdhvahastottānāsana, Utkāṭāsana, Pādahastāsana, Natarājāsana and Śavāsana
5. **प्राणायाम - Prāṇāyāma:** नाडीशोधन, अनुलोम-विलोम, सूर्यभेदी, उज्जायी व शीत्कारी – Nāḍīśodhana, Anuloma-Viloma, Sūryabhedṇṇ, Ujjāyṇṇ and Śītkārṇṇ
6. **मुद्रा व बन्ध – Mudrā and Bandha:** उड्डियानबन्ध, मूलबन्ध, जालन्धरबन्ध, विपरीतकरणी, तड़ागी, काकी व शाम्भवी – Uḍḍiyānabandha, Mūlabandha, Jālandharabandha, Viparṇṇtakaraṇṇ, Tāḍāgṇṇ, Kāki and Śāmbhavṇṇ
7. **ध्यान – Meditation:** ओङ्कारध्यान व प्रेक्षाध्यान – Oṅkāradhyāna and Prekṣādhyāna

आवश्यक पठनीय - Essential Readings:

- 1) स्वामी धीरेन्द्र ब्रह्मचारी, सूक्ष्म व्यायाम, मोरारजी देसाई नेशनल इंस्टिट्यूट ऑफ योग, निकट गोल डाकखाना, नई दिल्ली
- 2) O.P. Tiwari - Asana why and how, Kaivalyadham SMYM Samiti, Lonavala, 2012.
- 3) M.L. Gharote - Guidelines for Yogic Practices, Medha Publication, Lonavala.
- 4) स्वामी सत्यानन्द सरस्वती, आसन-प्राणायाम-मुद्रा-बन्ध, योग पब्लिकेशन्स ट्रस्ट, मुंगेर, बिहार-2006
- 5) पं. श्रीराम शर्मा, प्रज्ञा अभियान का योग व्यायाम, ब्रह्मवर्चस् शोध संस्थान, शान्तिकुञ्ज, हरिद्वार- 1998.

सन्दर्भ ग्रंथ- Suggested Readings:

1. B.K.S. Iyengar - Light on Yoga, Harper Collins Publisher, New Delhi, 2012.
2. B.K.S. Iyengar - Light on Pranayama, Harper Collins Publisher, New Delhi, 2012.
3. Swami Kuvlayanand - Asana, Kaivalyadham SMYM Samiti, Lonavala, 1993.

SLLCH YOG 1104 C 4105 – योगाभ्यास एवं मानवीय अवयव-संगठन व शरीर

संरचना -Human Anatomy, Physiology and Yogic Exercises - 1

UNIT I कोशिका, ऊतक, शरीर व मन का परिचय – Introduction to Cell, Tissue, Body and Mind

1. शरीर की परिभाषा, शरीर का षडंगत्व, पुरुष के आयुर्वेदोक्त चार भेद - चेतना-पुरुष, धातु-पुरुष, पंचविंशति-पुरुष, षड्धातु-पुरुष – Human Body, Its six types of organism, Four Types of Puruṣa according to Āyurveda – Catena-Puruṣa, Dhātu-Puruṣa, Pañcaviṁśati-Puruṣa, Ṣaḍdhātu- Puruṣa
2. मानवीय कोशिका - Human Cell संरचना व इसके विभिन्न अवयवों के कार्य - Structure and Functions
3. ऊतक की संरचना, प्रकार तथा कार्य – Structure, Types and Functions of Tissue
4. मन की परिभाषा, मन की उत्पत्ति, मन का स्थान, मन का निग्रह, मन के कर्म के संदर्भ में ध्यान समन्वय – Definition of Mind, Origin of Mind, Place of Mind, Keeping the Mind in Check, Meditational Sequence with regards to Functions of Mind

UNIT II अस्थि तन्त्र एवं योग- Skeletal System and Yoga

1. अस्थि की परिभाषा, अस्थि के भेद, अस्थि की संख्या, अस्थि की संरचना, अस्थि के कार्य – Definition of Bone, Types of Bones, Number of Bones, Structure of Bones, Function of Bones
2. तरुणास्थि/उपास्थि का स्थान, तरुणास्थि/उपास्थि के भेद और कार्य – Place of Cartilage, Types and Functions of Cartilage
3. सन्धि-स्थल, प्रकार, घुटने व कशेरुका सन्धि-स्थल की संरचना - Joints, their Types, Structure of the Joints of Knee and Vertebra
4. अस्थि-तंत्र पर योगाभ्यास का प्रभाव – Impact of Yoga on Skeletal System

UNIT III पेशीतन्त्र एवं योग - Muscle System and Yoga

1. मांस-धातु की संरचना, पेशी का परिचय, पेशियों की संख्या व भेद – Structure of Flesh, Introduction of Muscles, Number and Types of Muscles
2. पेशी की संरचना, पेशियों के कार्य – Structure of Muscle, Functions of Muscles
3. शरीर की प्रधान पेशियों का संक्षिप्त परिचय यथा फ्रन्टेलिस, आक्सीपीटोफ्रंटालिस, टेम्पोरोपेरन्टालिस, स्टर्नोक्लीडोमैस्टायड, लैटिसमस-डोरसाई, ट्रैपीजियस, रैक्टस-फेमोरिस, रैक्टस-एबडोमिनिस, डेल्टायड, बाइसेप्स-ब्राची, ट्राईसेप्स-ब्राची, ट्राईसेप्स-सुराए, ग्लूटियस-मैक्सिमस, रैक्टस-फेमोरिस, सारटोरियस, गैस्ट्रोक्नीमियस – Short

Introduction of Main Muscles of Body, for example - Frontalis, Occipitofrontalis, Sternocleidomastoid, Latissimus-dorsi, Trapezius, Rectus-femoris, Rectus-abdominis, Deltoid, Biceps-brachii, Triceps-brachii, Triceps-surae, Gluteus-maximus, Rectus-femoris, Sartorius, Gastrocnemius

4. योगाभ्यास का पेशी-तन्त्र पर प्रभाव – Impact of Yogic Exercises on Muscle system

UNIT IV श्वसन तन्त्र एवं योग - Respiratory System and Yoga

1. श्वसन की परिभाषा, श्वसन के भेद, श्वसन तन्त्र की संरचना, श्वसन की क्रिया - बाह्य व आन्तरिक – Definition of Respiration, Types of Respiration, Structure of Respiratory System, Inner and Outer Function of Respiration
2. गैसों का परिवहन, श्वसन-क्रिया की नियंत्रण प्रक्रियाएँ – Movement of Gases, Regulatory Functions of Respiration
3. श्वसन क्षमताएं व आयतनों की संक्षिप्त जानकारी – Capacity of Respiration and Short Information of Expansion
4. श्वसन तन्त्र पर योगाभ्यास का प्रभाव – Impact of Yogic Exercises on Respiratory System

UNIT V अन्तःस्रावी-तन्त्र, नाड़ी-तन्त्र एवं योग – Endocrinal System, Nervous System and Yoga

1. अन्तःस्रावी व बहिःस्रावी ग्रन्थियों का परिचय – Introduction to Endocrine and Exocrine Glands
2. एन्जाइमस व हार्मोन में अन्तर, पीयूष ग्रन्थि, पिनियल ग्रन्थि, परिचुल्लिका ग्रन्थि, चुल्लिका ग्रन्थि, बाल्य-ग्रन्थि (थाइमस) आदि ग्रन्थियों का परिचय – Difference between Enzyme and Harmon, Introduction to different Glands like – Pituitary Gland, Pineal Gland, Para-thyroid Gland, Thyroid Gland, Thymus etc.
3. अग्नाशय तथा एड्रीनल ग्रन्थि, डिम्ब व अण्डकोष ग्रन्थियों की स्थिति, हार्मोन व उनके कार्य – Pancreas and Adrenal Glands, Position of Ovaries and Testes, Harmon and their Functions
4. योगाभ्यास का अन्तःस्रावी व बहिःस्रावी ग्रन्थियों पर प्रभाव – Impact of Yogic Exercises on Endocrine and Exocrine System of Glands
5. नाड़ी-तन्त्र – सामान्य परिचय, विभिन्न भाग, संरचना एवं कार्य – Nervous System, General Information, Different Parts, Its Structure and Function

परीक्षक के लिए निर्देश: इस प्रश्न-पत्र में तीन खण्ड होंगे- अ, ब और स। “खण्ड अ” में पाँच अति लघु-उत्तरीय प्रश्न होंगे, जिनमें से प्रत्येक दो अंक का होगा। सभी प्रश्न अनिवार्य होंगे। “खण्ड ब” में दस लघु-उत्तरीय प्रश्न होंगे, जिनमें से पाँच प्रश्न करने होंगे तथा प्रत्येक चार अंकों का होगा। “खण्ड स” में आठ दीर्घ-उत्तरीय प्रश्न होंगे, जिनमें से चार प्रश्न करने होंगे तथा प्रत्येक दस अंकों का होगा। प्रश्न-पत्र सम्पूर्ण पाठ्यक्रम को ध्यान में रखकर बनाया जाएगा।

Instruction for Examiner: There will be three parts in this Question Paper - अ, ब and स. In first part अ there will be five very-short-answered compulsory questions carrying two marks each. In part ब there will be ten short-answered questions carrying four marks each and are to be attempted any five. The last part स will consist of eight long-answered

questions carrying ten marks each and are to be attempted any four. Question paper will be spread to the whole syllabus prescribed for this paper.

आवश्यक पठनीय - Essential Readings:

- 1) Shirley Teles, A Glimpses of Human Body, Swami Vivekanand Yoga Prakashan, Bangalore
- 2) M.M. Gore, Anatomy and Physiology of Yogic Practices, Motilal Banarsidass, New Delhi-2007
- 3) Ross and Wilson, Human Anatomy and Physiology in Health and Illness, Churchill Livingstone, 2010
- 4) पं. श्रीराम शर्मा, प्रज्ञा अभियान का योग व्यायाम, ब्रह्मवर्चस् शोध संस्थान, शान्तिकुञ्ज, हरिद्वार- 1998.

सन्दर्भ ग्रंथ- Suggested Readings:

1. Inderveer Singh, Anatomy and Physiology for Nurses, Jaypee Brothers Publishers, 2008
2. राकेश दीक्षित, शरीर-रचना एवं क्रिया-विज्ञान, भाषा भवन, मथुरा - 2005
3. डॉ. भास्कर गोविन्द घाणेकर, सुश्रुत (शरीर स्थान)
4. डॉ. मुकुन्द स्वरूप वर्मा, शरीर रचना विज्ञान
5. डॉ. प्रियव्रत शर्मा, शरीर क्रिया विज्ञान
6. डॉ. एस. आर. वर्मा, शरीर रचना व क्रिया विज्ञान
7. वैद्य रणजीत राय देसाई, आयुर्वेदीय क्रिया शरीर

SLLCH YOG 1105 C 4105 प्राचीन एवं मध्यकालीन प्रसिद्ध भारतीय दार्शनिक व योगी – Eminent Ancient and Medieval Philosophers and Yogis of India

UNIT I संक्षिप्त जीवन-वृत्त तथा दर्शन व योग के प्रति योगदान - Short Life Sketch and their Contribution to Philosophy and Yoga

1. महर्षि मनु - Maharṣi Manu, 2. महर्षि याज्ञवल्क्य - Maharṣi Yājñavalkya, 3. महर्षि अष्टावक्र - Maharṣi Aṣṭāvakra, 4. विदेह राजा जनक – Videha Rājā Janaka, 5. ऋषिका मैत्रेयी - Ṛṣikā Maitreyī,, 6. ऋषिका गार्गी – Ṛṣikā Gārgī,,

UNIT II संक्षिप्त जीवन-वृत्त तथा दर्शन व योग के प्रति योगदान - Short Life Sketch and their Contribution to Philosophy and Yoga and Yoga

1. महर्षि वाल्मीकि - Maharṣi Vālmiki, 2. महर्षि वेदव्यास - Maharṣi Vedavyāsa, 3. महर्षि वसिष्ठ - Maharṣi Vasiṣṭha, 4. महर्षि विश्वामित्र - Maharṣi Viśvāmitra

UNIT III संक्षिप्त जीवन-वृत्त तथा दर्शन व योग के प्रति योगदान Short Life Sketch and their Contribution to Philosophy and Yoga and Yoga

1. मुनि अक्षपाद गौतम – Muni Akṣapāda Gautama, 2. मुनि कणाद – Muni Kaṇāda, 3. मुनि कपिल - Muni Kapila, 4. पतञ्जलि - Muni Patañjali,

UNIT IV संक्षिप्त जीवन-वृत्त तथा दर्शन व योग के प्रति योगदान Short Life Sketch and their Contribution to Philosophy and Yoga and Yoga

1. मुनि जैमिनि - Muni Jaimini, 2. मुनि बादरायण - Muni Bādarāyaṇa, 3. मुनि गौतम बुद्ध - Muni Gautama

Buddha, 4. मुनि महावीर जिन – Muni Mahavira Jina

UNIT V संक्षिप्त जीवन-वृत्त तथा दर्शन व योग के प्रति योगदान Short Life Sketch and their Contribution to Philosophy and Yoga and Yoga

1. आदि शंकराचार्य - Ādi Śaṅkarācārya, 2. योगी मत्स्येन्द्रनाथ - Yogi Matsyendranātha, 3. योगी गोरक्षनाथ - Yogi Gorakshanātha, 4. सन्त ज्ञानेश्वर - Santa Jñāneśwara

परीक्षक के लिए निर्देश: इस प्रश्न-पत्र में तीन खण्ड होंगे- अ, ब और स। “खण्ड अ” में पाँच अति लघु-उत्तरीय प्रश्न होंगे, जिनमें से प्रत्येक दो अंक का होगा। सभी प्रश्न अनिवार्य होंगे। “खण्ड ब” में दस लघु-उत्तरीय प्रश्न होंगे, जिनमें से पाँच प्रश्न करने होंगे तथा प्रत्येक चार अंकों का होगा। “खण्ड स” में आठ दीर्घ-उत्तरीय प्रश्न होंगे, जिनमें से चार प्रश्न करने होंगे तथा प्रत्येक दस अंकों का होगा। प्रश्न-पत्र सम्पूर्ण पाठ्यक्रम को ध्यान में रखकर बनाया जाएगा।

Instruction for Examiner: There will be three parts in this Question Paper - अ, ब and स. In first part अ there will be five very-short-answered compulsory questions carrying two marks each. In part ब there will be ten short-answered questions carrying four marks each and are to be attempted any five. The last part स will consist of eight long-answered questions carrying ten marks each and are to be attempted any four. Question paper will be spread to the whole syllabus prescribed for this paper.

आवश्यक पठनीय - Essential Readings:

- 1) विश्वनाथ मुखर्जी, भारत के महान् योगी, विश्वविद्यालय प्रकाशन, नई दिल्ली - 2005
- 2) विश्वनाथ मुखर्जी, भारत की महान् साधिकायें, विश्वविद्यालय प्रकाशन, नई दिल्ली - 2005
- 3) कल्याण (भक्त अङ्क), गीता प्रेस गोरखपुर
- 4) कल्याण (सन्त अङ्क), गीता प्रेस गोरखपुर
- 5) पं. श्रीराम शर्मा, प्रज्ञा अभियान का योग व्यायाम, ब्रह्मवर्चस् शोध संस्थान, शान्तिकुञ्ज, हरिद्वार- 1998.

सन्दर्भ ग्रंथ- Suggested Readings:

1. कल्याण (योग-तत्त्वांक व योगाङ्क), गीता प्रेस गोरखपुर, क्रमशः 1991 व 2002
2. राकेश दीक्षित, शरीर-रचना एवं क्रिया-विज्ञान, भाषा भवन, मथुरा - 2005
3. डॉ. भास्कर गोविन्द घाणेकर, सुश्रुत (शरीर स्थान)
4. डॉ. मुकुन्द स्वरूप वर्मा, शरीर रचना विज्ञान



हरियाणा केंद्रीय विश्वविद्यालय

(संसद के अधिनियम संख्या-25 (2009) के तहत स्थापित)

जांट-पाली, महेंद्रगढ़- 123031 (हरियाणा)

CENTRAL UNIVERSITY OF HARYANA

(Established vide Act No. 25 (2009) of Parliament)

Jant-Pali, Mahendergarh-123031 (Haryana)

Annexure-VIII

No: CUH/2019/A&C/211

Date: 19.06.2019

अधिसूचना/NOTIFICATION

विषय: UG/PG/M.Phil./Ph.D. कार्यक्रम के छात्रों के लिए शुल्क संरचना, शुल्क भुगतान के निर्देश, छात्रों द्वारा देय अन्य शुल्क और शुल्क वापसी नियम-2019-20.

Sub: Fee Structure for the students of UG/PG/M.Phil./Ph.D. programmes, Instructions of Fee Payment, Other Fee Payable by the Students and Refund of Fee Rules 2019-20.

सभी संबंधित की जानकारी के लिए अधिसूचित किया जाता है कि UG/PG/M.Phil./Ph.D. कार्यक्रम के छात्रों के लिए शुल्क संरचना (मेस शुल्क के अतिरिक्त), शुल्क भुगतान के निर्देश, छात्रों द्वारा देय अन्य शुल्क और शुल्क वापसी नियम-2019-20, अनुलग्नक के अनुसार होंगे।

It is hereby notified for the information of all concerned that the Fee Structure (other than Mess Fee), Instructions of Fee Payment, Other Fee Payable by the Students and Refund of Fee Rules-2019-20, for the students of UG/PG/M.Phil./Ph.D. programmes, shall be as per the attached Annexure.

जितेंद्र मोर

Assistant Registrar

सहायक कुलसचिव

(Academic & Council Branch)

(शैक्षणिक एवं परिषद शाखा)

Copy forwarded to the following for information and necessary action:

प्रतिलिपि निम्नांकित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित:

1. All Dean/HoDs/TIC, CUH/ सभी अधिष्ठाता/विभागाध्यक्ष/प्रभारी शिक्षक, हर्केवि।
2. Dean Students Welfare, CUH/ अधिष्ठाता छात्र कल्याण, हर्केवि।
3. Finance Officer, CUH/ वित्त अधिकारी, हर्केवि।
4. Controller of Examinations, CUH/ परीक्षा नियंत्रक, हर्केवि।
5. Vice-Chancellor's Secretariat (for kind information of Vice-Chancellor), CUH/ कुलपति सचिवालय, (कुलपति महोदय के सूचनार्थ), हर्केवि।
6. Office of the Registrar (for kind information of Registrar), CUH/ कुलसचिव कार्यालय, (कुलसचिव महोदय के सूचनार्थ), हर्केवि।
7. ICT Section, CUH/ सूचना एवं कम्प्यूटर तकनीक अनुभाग, हर्केवि।

Proposed First Year Fee Structure

S.No.		Account Head	PG				UG			M.Phil.			Ph.D.		
			Humanities and Social Sciences	Sciences	Professional Courses	B.Ed.	M.Ed.	B.Tech.	B.Voc.	Humanities and Social Sciences	Sciences	Professional Courses	Humanities and Social Sciences	Sciences	Professional Courses
1		Security Deposit (Refundable)	1000	2000	2000	3000	3000	5000	2000	1000	1000	2000	2000	2000	
2		Admission Fee	500	1500	1500	2000	3000	3000	500	1000	1000	2500	2500	2500	
3		Enrolment Fee	600	600	600	600	600	600	600	600	600	1000	1000	1000	
4		Registration Fee	0	0	0	0	0	0	0	0	0	2000	2000	2000	
5		Identity Card	100	100	100	100	100	100	100	100	100	100	100	100	
6		Red Cross Fund	80	80	80	80	80	80	80	80	80	80	80	80	
7		NSS fee	20	20	20	20	20	20	20	20	20	20	20	20	
8		Insurance fee	200	200	200	200	200	200	200	200	200	200	200	200	
9		Student Welfare Fund	400	400	400	400	400	400	400	400	400	800	800	800	
10		Annual Day	100	100	100	100	100	100	100	100	100	100	100	100	
11		University Magazine	200	200	200	200	200	200	200	200	200	200	200	200	
12		Library Fee	1000	1000	1000	4000	6000	1000	1000	2000	2000	2000	2000	2000	
13		Tuition Fee	1000	1000	1000	5000	5000	36000	2570	2000	2000	1000	1000	1000	
14		Electricity/Water charges	300	300	300	300	300	300	300	500	500	600	600	600	
15		Cultural activities Fee	150	150	150	150	150	150	150	200	200	200	200	200	
16		Computer Lab Fee/InternetFee/ICT	400	400	400	1000	2000	400	400	1000	1000	3000	3000	3000	
17		Examination Fee	1000	3000	3000	3000	3000	6000	1000	2000	2000	2000	2000	2000	
18		University Development Fund	300	300	300	300	300	6000	300	500	500	2100	2100	2100	
19		Medical Charges	250	250	250	250	250	250	250	250	250	250	250	250	
20		Sports Fee	250	250	250	250	250	250	250	250	250	250	250	250	
21		Lab Fee/Industrial visit/field work/Internship	0	3000	3000	2000	3000	5000	1500	0	3000	0	2000	2000	
22		Student Academic activities	100	100	100	100	100	100	100	200	200	200	200	200	
23		Course Fee	0	0	0	5000	5000	0	0	0	0	0	0	0	
		Total in Rs	7950	14950	14950	28050	33050	65150	12020	12600	15600	20600	22600	22600	

Proposed Susequent/Final Year Annual Fee Structure

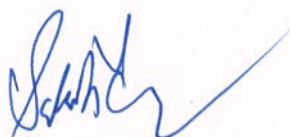

S.No.	Account Head	PG					UG			Ph.D.	
		Humanities and Social Sciences	Sciences	Professional Courses	B.Ed.	M.Ed.	B.Tech.	B.Voc.	Humanities and Social Sciences	Sciences	Professional Courses
1	Red Cross Fund	80	80	80	80	80	80	80	80	80	80
2	NSS fee	20	20	20	20	20	20	20	20	20	20
3	Insurance fee	200	200	200	200	200	200	200	200	200	200
4	Student Welfare Fund	400	400	400	400	400	400	400	500	500	500
5	Annual Day	100	100	100	100	100	100	100	100	100	100
6	University Magazine	200	200	200	200	200	200	200	200	200	200
7	Library Fee	1000	1000	1000	4000	6000	3600	1000	2000	2000	2000
8	Tuition Fee	1000	1000	1000	5000	5000	36000	2570	1000	1000	1000
9	Electricity/Water charges	300	300	300	300	300	300	300	600	600	600
10	Cultural activities Fee	150	150	150	150	150	150	150	200	200	200
11	Computer Lab Fee/InternetFee/ICT	500	500	500	1100	2100	500	500	3000	3000	3000
12	Examination Fee/Progress Evaluation Fee	2000	3000	3000	3000	5000	6000	1000	2000	2000	2000
13	University Development Fund	300	300	300	300	300	6000	300	2500	2500	2500
14	Medical Charges	250	250	250	250	250	250	250	250	250	250
15	Sports Fee	250	250	250	250	250	250	250	250	250	250
16	Lab Fee/Industrial visit/field work/Internship	0	3000	3000	5000	5000	6000	2600	0	2000	2000
17	Student Academic activities	100	100	100	100	100	100	100	200	200	200
18	Course Fee	0	0	0	5000	5000	0	0	0	0	0
	Total in Rs	6850	10850	10850	25450	30450	60150	10020	13100	15100	15100

Signature

5/12/2019


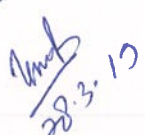
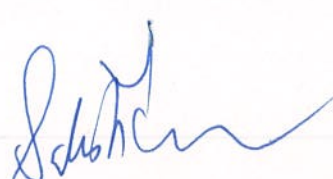
Instructions for Fee Payment.

1. The fees for M.A. Psychology shall be at par with the Science Courses.
2. Professional Courses include M.B.A., LL.M., M.C.A., M.A. J.M.C., M.H.M.C.T., M. Lib.& In. Sc., M.T.T.M., M.Pharm, LL.B., M.P.ED. or any other professional course introduced by the University
3. The fee shall be submitted by the students within 10 working days of the commencement of session for 2nd and subsequent years. However, fee for the first year is to be submitted along with admission.
4. Late Fee/Fine: Rs. 500/- within 15 days after due date; there after Rs. 50/Day with permission of respective Dean's.
5. The student will not be allowed to appear in End Term Examination if fee is not paid before 15 days of the commencement of the term end examinations on the recommendation of respective Dean.
6. SC/ST Students: The SC/ST Students may pay their annual fees in three instalments.
7. First Instalment: Admission Fees, Enrolment Fees, Identity Card Fee, Insurance Fee, Security deposit
8. Remaining fees may be paid in two equal instalments upto 15 days from the commencement of the Term End Examinations.
9. Tuition fee exempted for SC/ST Students.
10. Security Deposit: Security deposit can be claimed by the student within one year, after completing a course after that it will be forfeited. However, an amount of Rs. 500/- will be deducted automatically from the Security Deposit towards Alumni Registration.
11. The students shall bear the expenses of fee, if any, prescribed for Uniform and other such expenses, wherever necessary.
12. Fee refund as per the University fee refund rules, as amended from time to time.
13. The students need to pay the fee as per the fee structure prevailing in the year of admission throughout his/her tenure.
14. Readmission Fee: If a student is not attending classes without sanctioned leave for more than 10 working days, his/her name shall be struck off from the roll and he/she shall be required to pay Rs. 750 as Re-admission fee after due approval from Head of the Department /Dean of the concerned School. The same fee is applicable for students seeking re-admission after availing Zero semester/Non-promoted cases.



OTHER FEE PAYABLE BY THE STUDENTS

Sr. No.	Particulars	Fee Amount (Rs.)
1.	Duplicate Identity Card	100
2.	Migration Certificate	400
3.	Provisional Result	250
4.	Provisional Degree	300
5.	Re-Admission Fee	750
6.	Duplicate Detailed Marks Certificate (DMC/Mark sheet)	200
7.	Revaluation Fee	1000 (per paper)
8.	Re-Appeal Fee	600 (per paper)
9.	Official Transcript Fee	1000 (per copy)
10.	Degree Fee/Duplicate Degree	500
11.	Duplicate Hall Ticket	100
12.	Verification of Degree/ Marks Card	500
13.	Ph.D. thesis Submission	5000
14.	M.Phil. thesis Submission	3000
15.	Photocopy of Answer Booklets	500

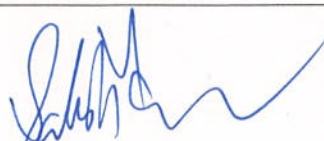
Central University of Haryana Refund of Fee rules 2019-20

Sr. No.	Percentage of Refund of Fees	Point of time when notice of withdrawal of admission is received in the HEI
1.	100%	15 days or more before the formally-notified last date of admission (Excluding Open Counselling)
2.	90%	less than 15 days before the formally-notified last date of admission (Excluding Open Counselling)
3.	80%	15 days or less after the formally-notified last date of admission (Excluding Open Counselling)
4.	50%	30 days or less, but more than 15 days, after formally-notified last date of admission (Excluding Open Counselling)
5.	00%	More than 30 days after formally-notified last date of admission (Excluding Open Counselling)

Additional Rules

Sr. No.	Reasons for seeking refund	Quantum of fee to be refunded
1.	When Admission is made inadvertently due to error/omission/ commission on the part of the University	Full fee including examination fee
2.	When cancellation of admission is due to concealment/falsification of facts, submission of false/ fake certificate(s), non-submission of the required documents, providing misleading information by the student or for any error/mistake on the part of the student	No fee to be refunded
3.	If a student provisionally admitted to a programme on declaration of the result of his/her qualifying examination/compartmental examination become ineligible for admission and his/her admission is cancelled	50% of total fee + security deposit
4.	In case a student, after his/her admission, expires within one	Full fee will be refunded to his/her parents.







	month of the last date of admission	
5.	When a student has been allowed to change the programme of study within the departments of the University	After adjustment of fees already paid, the student will be required to pay the remaining amount as prescribed for the new programme. In case the amount paid by the student in the previous programme is more than the amount due for the second programme, the excess amount will be refunded.
6.	Cancellation due to non - submission of migration certificate, category certificate or other essential document till last date specified during admission	No fee will be refunded except security deposit
8	When a student of self-financing programme applies for the withdrawal of admission on or before the last date of admission (Excluding Open Counselling)	Full fee after deduction of Rs. 1000/-.

Refund of hostel dues shall be made as per the Hostel Rules in force and as amended from time to time.

In all cases, securities deposit/caution money (if any) shall be refunded after submission of clearance from the relevant departments, provided he/she applies for refund of the same within a period of one year from the date of leaving the institution

**MEMORANDUM OF UNDERSTANDING
(MoU)**

BETWEEN

CENTRAL UNIVERSITY OF HARYANA, MAHENDERGARH

&

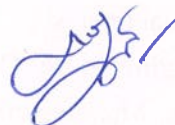
HITECH ENVIRO ENGINEERS AND CONSULTANTS PVT. LTD.

FOR

**SKILL DEVELOPMENT, OUTCOME BASED TRAININGS,
PLACEMENT, R&D SERVICES AND RELATED SERVICES**



हरियाणा केन्द्रीय विश्वविद्यालय
मॉड - जौंट वाली
जिला - महेन्द्रगढ़ - 123029



MEMORANDUM OF UNDERSTANDING

This **Memorandum of Understanding** (hereinafter called as the 'MOU') is entered into on this the 03rd day of April – Two Thousand and nineteen (03/04/2019), by and between

CENTRAL UNIVERSITY OF HARYANA, JANT-PALI, MAHENDERGARH represented herein by **Sh. RAM DUTT, REGISTRAR, CENTRAL UNIVERSITY OF HARYANA**, (hereinafter referred as 'First Party', the institution which expression, unless excluded by or repugnant to the subject or context shall include its successors – in-office, administrators and assigns).

AND

HITECH ENVIRO ENGINEERS AND CONSULTANTS PVT. LTD. (HEECPPL), the **Second Party**, and represented herein by its **SENIOR PROJECT MANAGER, ER. RAJ KUMAR**, (hereinafter referred to as "Second Party", company which expression, unless excluded by or repugnant to the subject or context shall include its successors – in-office, administrators and assigns).

(First Party and Second Party are hereinafter jointly referred to as 'Parties' and individually as 'Party') as

WHEREAS:

- A) First Party is a Higher Educational Institution named:
- **CENTRAL UNIVERSITY OF HARYANA, MAHENDERGARH**
- B) First Party & Second Party believe that collaboration and co-operation between themselves will promote more effective use of each of their resources, and provide each of them with enhanced opportunities.
- C) The Parties intent to cooperate and focus their efforts on cooperation within area of Skill Based Training, Education and Research.
- D) Both Parties, being legal entities in themselves desire to sign this MOU for advancing their mutual interests.
- E) **Hitech Enviro Engineers & Consultants Pvt. Ltd.**, the Second Party is engaged in Business, Manufacturing, Skill Development, Education and R&D

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हरियाणा केन्द्रीय विश्वविद्यालय
जॉट पाली
महेंद्रगढ़ - 123029

Services in the fields of – *water and wastewater treatment plant, Environmental health and safety* and other related fields

- F) **Hitech Enviro Engineers & Consultants Pvt. Ltd.**, the Second Party is located in A-1, GROUND FLOOR, KAUSHAMBHI, GHAZIABAD-201010 and background of the Company. Hitech Enviro Engineers & Consultants Pvt. Ltd. provides complete water & wastewater treatment solutions and online monitoring instrumentation to the buildings and industrial sector. We are a leading manufacturer of modular and scalable water and wastewater treatment plants as well as air pollution control devices. We follow stringent quality control and health & safety measures at all stages of our process. We are ISO 9001:2008 and OHSAS 18001:2007 certified. Our USP is the comprehensive set of: consulting services, chemicals & equipment solutions and online monitoring instrumentation, for 3600 Pollution Management - all under one roof helping our customers manage and optimize their air & water resources and process challenges across industries and municipalities. We provide consulting services ranging from EIA studies, CTE, CTO, CGWA etc. and keep our clients constantly updated with latest regulatory norms helping them to stay in compliance, always.

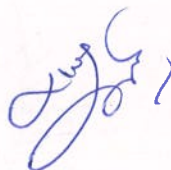
NOW, THEREFORE IN CONSIDERATION OF THE MUTUAL PROMISES SET FORTH IN THIS MOU, THE PARTIES HERE TO AGREE AS FOLLOWS:

CLAUSE 1 CO-OPERATION

- 1.1 Both Parties are united by common interests and objectives, and they shall establish channels of communication and co-operation that will promote and advance their respective operations within the **Institution** and its related wings. The Parties shall keep each other informed of potential opportunities and shall share all information that may be relevant to secure additional opportunities for one another.
- 1.2 **CENTRAL UNIVERSITY OF HARYANA, JANT-PALI, MAHENDRAGARH and HITECH ENVIRO ENGINEERS AND CONSULTANTS PVT LTD (HEECPL)** co-operation will facilitate effective utilization of the intellectual capabilities of the faculty of First Party providing

Page 3 of 7

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हार्दयानगर विश्वविद्यालय
ग्राहक - जगत पाली
जिला - गुरुग्राम - 123029



significant inputs to them in developing suitable teaching / training systems, keeping in mind the needs of the industry, the Second Party.

- 1.3 The general terms of co-operation shall be governed by this MOU. The Parties shall cooperate with each other and shall, as promptly as is reasonably practical, enter into all relevant agreements, deeds and documents (the 'Definitive Documents') as may be required to give effect to the actions contemplated in terms of this MOU. The term of Definitive Documents shall be mutually decided between the Parties. Along with the Definitive Documents, this MOU shall represent the entire understanding as to the subject matter hereof and shall supersede any prior understanding between the Parties on the subject matter hereof.

CLAUSE 2 SCOPE OF THE MoU

- 2.1 The budding graduates from the institutions could play a key role in technological up-gradation, innovation and competitiveness of an industry. Both parties believe that close co-operation between the two would be of major benefit to the student community to enhance their skills and knowledge.
- 2.2 **Curriculum Design:** Second Party will give valuable inputs to the First Party in teaching / training methodology and suitably customize the curriculum so that the students fit into the industrial scenario meaningfully.
- 2.3 **Industrial Training & Visits:** Industry and Institution interaction will give an insight into the latest developments / requirements of the industries; the Second Party to permit the Faculty and Students of the First Party to visit its group companies and also involve in Industrial Training Programs for the First Party. The industrial training and exposure provided to students and faculty through this association will build confidence and prepare the students to have a smooth transition from academic to working career. The Second Party will provide its Labs / Workshops / Industrial Sites for the hands-on training of the learners enrolled with the First Party.

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हमिना -
गौन - जॉट पाली
जिला - महेन्द्रगढ़ - 123029

- 2.4 **Research and Development:** Both Parties have agreed to carry out the joint research activities in the fields of - **Water and Wastewater Treatment and Industrial Waste Management**
- 2.5 **Skill Development Programs:** Second Party to train the students of First Party on the emerging technologies in order to bridge the skill gap and make them industry ready.
- 2.6 **Guest Lectures:** Second Party to extend the necessary support to deliver guest lectures to the students of the First Party on the technology trends and in house requirements.
- 2.7 **Faculty Development Programs:** Second Party to train the Faculties of First Party for imparting training as per the industrial requirement considering the National Occupational Standards in concerned sector, if available.
- 2.8 **Placement of Trained Students:** Second Party will actively engage to help the delivery of the training and placement of students of the First Party into internships/jobs; and will facilitate placements for at least 25-50% of the students. The Second Party will itself absorb at least 25-50% percentage of the trained students subject to their capability .
- 2.9 Both Parties to obtain all internal approvals, consents, permissions, and licenses of whatsoever nature required for offering the programmes on the terms specified herein
- 2.10 **There is no financial commitment on the part of the CENTRAL UNIVERSITY OF HARYANA, the First Party to take up any programme mentioned in the MoU. If there is any financial consideration, it will be dealt separately.**

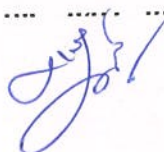
CLAUSE 3 INTELLECTUAL PROPERTY

- 3.1 Nothing contained in this MOU shall, by express grant, implication, Estoppel or otherwise, create in either Party any right, title, interest, or license in or to the intellectual property (including but not limited to know-how, inventions, patents, copyrights and designs) of the other Party.

CLAUSE 4 VALIDITY

Page 5 of 7

रजिस्ट्रार
हमिन्दू विश्वविद्यालय
गौध - जॉट पाली
जिला - मेरठ - 123029



- 4.1 This Agreement will be valid until it is expressly terminated by either Party on mutually agreed terms, during which period **HEECPL**, the Second Party, as the case may be, will take effective steps for implementation of this MOU. Any act on the part of **HITECH ENVIRO ENGINEERS AND CONSULTANTS PVT. LTD. (HEECPL)** after termination of this Agreement by way of communication, correspondence, etc., shall not be construed as an extension of this MOU
- 4.2 Both Parties may terminate this MOU upon 30 calendar days' notice in writing. In the event of termination, both parties have to discharge their obligations

CLAUSE 5 RELATIONSHIP BETWEEN THE PARTIES

- 5.1 It is expressly agreed that **CENTRAL UNIVERSITY OF HARYANA, JANT-PALI, MAHENDERGARH** and **HITECH ENVIRO ENGINEERS AND CONSULTANTS PVT. LTD. (HEECPL)** are acting under this MOU as independent contractors, and the relationship established under this MOU shall not be construed as a partnership. Neither Party is authorized to use the other Party's name in any way, to make any representations or create any obligation or liability, expressed or implied, on behalf of the other Party, without the prior written consent of the other Party. Neither Party shall have, nor represent itself as having, any authority under the terms of this MOU to make agreements of any kind in the name of or binding upon the other Party, to pledge the other Party's credit, or to extend credit on behalf of the other Party.

रजिस्ट्रार First Party

हरियाणा केन्द्रीय विधानमण्डल

गोंय - जौट

जिला - पटेलपुर - 123029



Second Party

Any divergence or difference derived from the interpretation or application of the MoU shall be resolved by arbitration between the parties as per the Arbitration Act, 1996. The place of the arbitration shall be at district head quarters of the First Party. This undertaking is to be construed in accordance with Indian Law with exclusive jurisdiction in the Court of Delhi.

AGREED:

For **CENTRAL UNIVERSITY OF HARYANA,**
MAHENDERGARH

For **HITECH ENVIRO**
ENGINEERS AND
CONSULTANTS PVT.
LTD.

रजिस्ट्रार

हरियाणा

मॉड - जॉट पाली

जिला - महेंद्रगढ़ - 123 029

Authorized Signatory



Authorized Signatory

Name of the Institute: CENTRAL UNIVERSITY OF HARYANA, MAHENDERGARH	Name of the Institute: HITECH ENVIRO ENGINEERS AND CONSULTANTS PVT. LTD.
Address: Central University of Haryana, Jant-Pali, Mahendergarh, Haryana	Address: A-1, GROUND FLOOR, KAUSHAMBHI, GHAZIABAD-201010
Contact details: Sh. Ram Dutt, Registrar, Central University of Haryana, Telephone:01285-249401	Contact details: Sh Raj Kumar, Senior Project Manager, HITECH ENVIRO ENGINEERS AND CONSULTANTS PVT. LTD. 0120-4294461,62,63
Email ID: registrar@cuh.ac.in	Email ID: info@heecpl.com
Website: www.cuh.ac.in	Website: www.heecpl.com

Witness 1:

(Dr. Raman Kumar Mhurya)
3/4/19

Witness 2:

(Dr. Anoop Yadav)

Witness 3:

(Signature)

Witness 4:

**MEMORANDUM OF UNDERSTANDING
(MoU)**

BETWEEN

CENTRAL UNIVERSITY OF HARYANA, MAHENDERGARH

&

DESHWAL WASTE MANAGEMENT PVT LTD

FOR

**SKILL DEVELOPMENT, OUTCOME BASED TRAININGS,
PLACEMENT, R&D SERVICES AND RELATED SERVICES**



Indian-Non Judicial Stamp Haryana Government



Date : 20/05/2019

Certificate No. G0T2019E1167



GRN No. 47684298

Stamp Duty Paid : ₹ 101
(Rs. Only)

Penalty : ₹ 0

(Rs. Zero Only)

Seller / First Party Detail

Name: Central University Of haryana

H.No/Floor : Na

Sector/Ward : Na

LandMark : Na

City/Village : Gurugram

District : Gurugram

State : Haryana

Phone: 0



Buyer / Second Party Detail

Name : Deshwal Waste Management pvt ltd

H.No/Floor : Na

Sector/Ward : Na

LandMark : Na

City/Village: Gurugram

District : Gurugram

State : Haryana

Phone : 0

Purpose : AGREEMENT

The authenticity of this document can be verified by scanning this QrCode Through smart phone or on the website <https://egrashry.nic.in>

MEMORANDUM OF UNDERSTANDING

This **Memorandum of Understanding** (hereinafter called as the 'MOU') is entered into on this the 22nd day of May 2019, by and between

CENTRAL UNIVERSITY OF HARYANA, JANT-PALI, MAHENDERGARH, represented herein by **Sh. RAM DUTT, REGISTRAR, CENTRAL UNIVERITY OF HARAYANA,** (hereinafter referred as '**First Party**', the institution which expression, unless excluded by or repugnant to the subject or context shall include its successors – in-office, administrators and assigns).

AND

DESHWAL WASTE MANAGEMENT PVT LTD (DWMPL), the Second Party, and represented herein by its **RAJU YADAV, DIRECTOR** (hereinafter referred to as "**Second Party**", a company which expression, unless excluded by or repugnant to the subject or context shall include its successors – in-office, administrators and assigns).

(First Party and Second Party are hereinafter jointly referred to as 'Parties' and individually as 'Party') as



WHEREAS:

- A) First Party is a Higher Educational Institution named:
 - **CENTRAL UNIVERSITY OF HARYANA, MAHENDEGARH**
- B) First Party & Second Party believe that collaboration and co-operation between themselves will promote more effective use of each of their resources, and provide each of them with enhanced opportunities.
- C) The Parties intent to cooperate and focus their efforts on cooperation within areas of Skill Based Training, Education and Research.
- D) Both Parties, being legal entities in themselves desire to sign this MOU for advancing their mutual interests.
- E) **Deshwal Waste Management Pvt. Ltd.**, the Second Party is engaged in Business, Manufacturing, Skill Development, Education and R&D Services in the fields of – *E-Waste Management* and other related fields
- F) **Deshwal Waste Management Pvt. Ltd.**, the Second Party is located in Plot No.292, Sector-7, IMT Manesar, Gurugram-122048. Deshwal waste management provides complete one stop solution in the field of E-Waste treatment. We follow stringent quality control and health & safety measures at all stages of our process. We are ISO 9001:2015 and OHSAS 18001:2007 certified, 14001-2015 Environment Management System, R2-2008 Responsible Recycling, 27001-2013 and Information Security Management System.

NOW, THEREFORE, IN CONSIDERATION OF THE MUTUAL PROMISES SET FORTH IN THIS MOU, THE PARTIES HERE TO AGREE AS FOLLOWS:

CLAUSE 1 CO-OPERATION

- 1.1 Both Parties are united by common interests and objectives, and they shall establish channels of communication and co-operation that will promote and advance their respective operations within the **Institution** and its related wings. The Parties shall keep each other informed of potential opportunities and shall share all information that may be relevant to secure additional opportunities for one another.

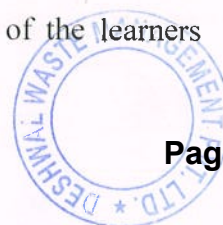


- 1.2 CENTRAL UNIVERSITY OF HARYANA, JANT-PALI, MAHENDERGARH and DESHWAL WASTE MANAGEMENT PVT LTD (DWMPL) co-operation will facilitate effective utilization of the intellectual capabilities of the faculty of First Party providing significant inputs to them in developing suitable teaching / training systems, keeping in mind the needs of the industry, the Second Party.
- 1.3 The general terms of co-operation shall be governed by this MOU. The Parties shall cooperate with each other and shall, as promptly as is reasonably practical, enter into all relevant agreements, deeds and documents (the 'Definitive Documents') as may be required to give effect to the actions contemplated in terms of this MOU. The term of Definitive Documents shall be mutually decided between the Parties. Along with the Definitive Documents, this MOU shall represent the entire understanding as to the subject matter hereof and shall supersede any prior understanding between the Parties on the subject matter hereof.

CLAUSE 2

SCOPE OF THE MoU

- 2.1 The budding graduates from the institutions could play a key role in technological up-gradation, innovation and competitiveness of an industry. Both parties believe that close co-operation between the two would be of major benefit to the student community to enhance their skills and knowledge.
- 2.2 **Curriculum Design:** Second Party will give valuable inputs to the First Party in teaching / training methodology and suitably customize the curriculum so that the students fit into the industrial scenario meaningfully.
- 2.3 **Industrial Training & Visits:** Industry and Institution interaction will give an insight into the latest developments / requirements of the industries; the Second Party to permit the Faculty and Students of the First Party to visit its group companies and also involve in Industrial Training Programs for the First Party. The industrial training and exposure provided to students and faculty through this association will build confidence and prepare the students to have a smooth transition from academic to working career. The Second Party will provide its Labs / Workshops / Industrial Sites for the hands-on training of the learners enrolled with the First Party.



- 2.4 **Research and Development:** Both Parties have agreed to carry out the joint research activities in the fields of – **Electrical & Electronic Waste Management**
- 2.5 **Skill Development Programs:** Second Party to train the students of First Party on the emerging technologies in order to bridge the skill gap and make them industry ready.
- 2.6 **Guest Lectures:** Second Party to extend the necessary support to deliver guest lectures to the students of the First Party on the technology trends and in house requirements.
- 2.7 **Faculty Development Programs:** Second Party to train the Faculties of First Party for imparting training as per the industrial requirement considering the National Occupational Standards in concerned sector, if available.
- 2.8 **Placement of Trained Students:** Second Party will actively engage to help the delivery of the training and placement of students of the First Party into internships/jobs; and will facilitate placements for at least 25-50% of the students. The Second Party will itself absorb at least 25-50% percentage of the trained students subject to their capability.
- 2.9 Both Parties to obtain all internal approvals, consents, permissions, and licenses of whatsoever nature required for offering the programmes on the terms specified herein
- 2.10 **There is no financial commitment on the part of the CENTRAL UNIVERSITY OF HARYANA,** the First Party to take up any programme mentioned in the MoU. If there is any financial consideration, it will be dealt separately.

CLAUSE 3 INTELLECTUAL PROPERTY

- 3.1 Nothing contained in this MOU shall, by express grant, implication, estoppel or otherwise, create in either Party any right, title, interest, or license in or to the intellectual property (including but not limited to know-how, inventions, patents, copyrights and designs) of the other Party.



CLAUSE 4

VALIDITY

- 4.1 This Agreement will be valid until it is expressly terminated by either Party on mutually agreed terms, during which period **Deshwal Waste Management Pvt. Ltd.**, the Second Party, as the case may be, will take effective steps for implementation of this MOU. Any act on the part of **Deshwal Waste Management Pvt. Ltd. (DWMPL)** after termination of this Agreement by way of communication, correspondence, etc., shall not be construed as an extension of this MOU.
- 4.2 Both Parties may terminate this MOU upon 30 calendar days' notice in writing. In the event of Termination, both parties have to discharge their obligations.

CLAUSE 5

RELATIONSHIP BETWEEN THE PARTIES

- 5.1 It is expressly agreed that **CENTRAL UNIVERSITY OF HARYANA, JANT-PALI, MAHENDERGARH** and **DESHWAL WASTE MANAGEMENT PVT LTD (DWMPL)** are acting under this MOU as independent contractors, and the relationship established under this MOU shall not be construed as a partnership. Neither Party is authorized to use the other Party's name in any way, to make any representations or create any obligation or liability, expressed or implied, on behalf of the other Party, without the prior written consent of the other Party. Neither Party shall have, nor represent itself as having, any authority under the terms of this MOU to make agreements of any kind in the name of or binding upon the other Party, to pledge the other Party's credit, or to extend credit on behalf of the other Party.



First Party
22/5/2019

Second Party
22/05/2019

Any divergence or difference derived from the interpretation or application of the MoU shall be resolved by arbitration between the parties as per the Arbitration Act, 1996. The place of the arbitration shall be at District Head Quarters of the First Party. This undertaking is to be construed in accordance with Indian Law with exclusive jurisdiction in the Courts of Delhi.

AGREED:

For **CENTRAL UNIVERSITY OF HARYANA,
MAHENDERGRAH**

For **DWMPL**

Authorized Signatory
कुल सचिव/Registrar
हरियाणा केंद्रीय विश्वविद्यालय
Central University of Haryana
महेन्द्रगढ़ हरियाणा-123029
Mahendergarh, Haryana-123029

Authorized Signatory
22/05/2019

CENTRAL UNIVERSITY OF HARYANA, MAHENDERGRAH	DESHWAL WASTE MANAGEMENT PVT. LTD.,
Central University of Haryana, Jant-Pali, Mahendergarh	PLOT NO.292, SECTOR 7 IMT MANESAR HARYANA-122050
Sh. Ram Dutt, Registrar, Central University of Haryana, Telephone:01285-249401	Mr. Rakesh Kumar,V.P., Deshwal Waste Management Pvt. Ltd Gurugram 9910055057
registrar@cuh.ac.in	info@dwmpl.com
www.cuh.ac.in	www.dwmpl.com

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Witness 2:

VARUN JAIN
22-05-2019

Witness 3:

Dr. Anoop Yadav

Witness 4:

PRABHAT KUMAR