

**Department of Biochemical Engineering and Biotechnology**  
**Minutes of DRC Meeting N0 07/2017-2018**

16th April, 2018

The seventh meeting of *Departmental Research Committee (DRC)* for the academic session 2017-2018 was held on **Monday, April 16, 2018** at **12 noon** in the Committee Room (I- 230) of the Department.

The following members were present:

Prof. T. R. Sreekrishnan (*Chairperson*)  
Prof. Saroj Mishra  
Prof. A K Srivastava  
Prof. Prashant Mishra  
Prof. Atul Narang  
Prof. D. Sundar  
Prof. Ritu Kulshreshtha  
Prof. Preeti Srivastava  
Prof. Z. A. Shaikh  
Prof. Ashish Misra  
Prof. Shilpi Sharma (*Convenor*)

1. To confirm the minutes of the 6th meeting of the DRC for the session 2017-2018 held on 21st Dec 2017.

The minutes of 6th meeting of DRC 2017-18 held on 7th Feb 2018 were confirmed as circulated.

2. To report the matters arising from minutes of Meeting No. 06/2017-2018 and action taken

*Item No 10c* Based on the nominations received from faculty members, the sub-committee forwarded the names of three doctoral students: Mr Gautam Anand (2013BEZ8024), Ms Jaspreet Kaur Dhanjal (2013BEZ8509) and Ms Richa Sharma (2013BEZ8026) for presentations on Science Day, in response to request received from Dean Academics.

3. Allotment of topics for MTP Part 1 to Dual Degree students (Entry Year 2014)

The Committee approved the allotment of projects for students who will be pursuing BTP-1 and MTP based on the choices and availability (Annexure 1)

4. Allotment of topics for MTP Part 2 to Dual Degree students: Bhaskar Singh (Entry No 2007BB50011) & T.R.K. Saran (Entry No 2010BB50042)

The Committee approved the allotment of topics to following students:

- *Bhaskar Singh*: Effect of stress on nodulation in *Cajanus cajan* (Prof. Shilpi Sharma)
- *T R K Saran*: A computational resource for CRISPR-Cas9 based genome editing (Prof. D. Sundar)

5. Selection of students for Ph.D. and MSR Programs (2018-2019, 1st Semester).

The Chairman informed the Committee about the Institute Schedule for PG admissions for 1st Semester 2018-2019. The Committee decided that the written test/interview for admission

to Ph.D./MSR programs in the Department would be conducted during **May 22-23, 2018**. Prof. D. Sundar (Biosciences) and Prof Ashish Misha (Bioengineering) will coordinate the setting of question paper. Faculty members were requested to send questions for PhD screening test to the respective coordinators latest by **30th April 2018**. Conduct of the examination will be coordinated by the sub-committee comprising of Prof. T. R. Sreekrishnan, Prof. Saroj Mishra, Prof. A. K. Srivastava, Prof. Prashant Mishra, and Prof. Ritu Kulshreshtha. The shortlisting criteria approved by the Committee for admission to Ph.D. and M.S.(Res) programs are given in Annexures 2 and 3.

6. Comprehensive examination for Ph.D. students of the department

The committee discussed the recommendations put forth by the sub-committee formed for developing a new format for comprehensive examination (Annexure 4). The committee approved of the recommendations with the following modifications:

*\*Syllabus of Paper 2 of written comprehensive examination is to be framed by the respective SRC. This is to be brought to DRC with other documents including question paper, answer sheets and date of exam, for ratification.*

It was decided to conduct the written comprehensive examination (Paper I) on **14th May 2018**. Prof Atul Narang (Bioengineering) and Prof Shilpi Sharma (Biosciences) will coordinate the setting of question paper and conduct the examination.

7. Requests received from Ph.D. students to continue their fellowship during ex-India leave

Name	Duration of leave	Host Institution
Rohit Khandelwal 2015BEZ8355	1 year	Kobe University, Japan
Gautam Anand 2013BEZ8024	3 months	Ceske Budejovice, Czech Republic

The Head was requested to forward the applications to Dean Academics. (Action: Head, DBEB)

8.Appointment of chairperson for SRC of Ms Sonam Takkar (2013BEZ8030)

Prof. Preeti Srivastava was appointed as the new Chairperson for SRC of Ms Sonam Takkar (2013BEZ8030), in place of Late Prof. P. K. Roychoudhury.

9. To report the matters for ratification by the DRC

(a) Project proposals submitted by departmental faculty

S. No	Project Title	Project Investigators	Funding Agency
1	Development of miRNA based nanotherapeutics for targeting bacterial pathogen and antibiotic resistance	Monica Saifi (mentor Prof. Prashant Mishra)	DST
2	Improvisation of air quality in Delhi NCR and India by removing the pollutants at the source	Prof.Preeti Srivastava	CPCB
3	Pavitra Ganga: Unlocking wastewater treatment, water re-use and resource recovery opportunities for urban and peri-urban areas in India	Prof. T. R. Sreekrishnan & Prof. Z. Ahammad	DST-DBT-EU

4	Synthetic microbial community as a novel approach to combat biotic stress in pigeonpea	Dr. Sakshi Tewari (Mentor: Prof. Shilpi Sharma)	SYST
5	Domesticating the microbiome for biocontrol of fungal pathogens in agriculture	Prof. Shilpi Sharma & Prof. Satyawati Sharma (CRDT)	DBT (Indo-Swiss)
6	Directed evolution of enzymes via high-throughput screening using droplet microfluidics	Prof. R. Elangovan	1234, IITD

The above projects were circulated to members, since no specific comments were received from the members on the proposal, the project was forwarded to Dean IRD and item was ratified in DRC.

It was decided that proposals from applications under post-doctoral schemes be waived off the two day waiting period before Head's approval on IRIS.

(c) Names of foreign examiners for Ph.D. thesis of Mr. Sunil Kumar (2011BEZ8480)  
Fresh list of foreign examiners for Ph.D. thesis of Mr Sunil Kumar (2011BEZ8480) was forwarded to Dean Academics after due circulation to DRC members for their inputs.

#### 10. Any other item with the permission of Chair

##### (a) Project proposals submitted by departmental faculty

S. No	Project Title	Project Investigators	Funding Agency
1	DOSA: Diagnostics for one health and user driven solutions forAMR	Prof. R. Elangovan	DBT-ESRC (UK)
2	Exploring glioblastoma vulnerabilities by addressing tumor heterogeneity and the role of non-coding RNA in shaping hypoxia-driven gene expression	Prof. Ritu Kulshreshtha	DBT (Indo-Swiss)
3	Understanding responses of soil denitrifiers to agrochemical amendments (individual and in combinations) in <i>Vigna radiata</i> (mung bean) rhizosphere using metaproteogenomic approach	Dr. Manish Kaushik [Mentor: Prof. Shilpi Sharma]	SERB NPDF

The above projects were circulated to members, since no specific comments were received from the members on the proposal, the project was forwarded to Dean IRD and item was ratified in DRC.

##### (b) Ex-India leave request by two doctoral students

The committee approved the request for ex-India leave as per the following details:

- Gautam Anand (2013BEZ8024) for a period of three months towards EMBO fellowship
- Richa Sharma (2013BEZ8026) for a period of 9 days towards paper presentation in ESM at Helsinki Finland

(c) Research Scholar Travel Award application of Ms Richa Sharma (2013BEZ8026) to present paper in Ecology of Soil Microorganisms, Helsinki, Finland in June 2018 was recommended to be forwarded to Dean Academics

(d) Plan of Work seminar of MSR student Ms Shruthi Lakshmi P. (2017BEY7505)

The Plan of Work for MS Res student Ms Shruthi Lakshmi P. was discussed, and approved on the basis of recommendations by the members of SRC.

(Action: Chairman DRC to forward the Form w/ enclosures to Dean - Academics)

(e) Fellowship for doctoral student Ms Anamika Singh (2011BEZ8228)  
Prof Atul Narang's request of fellowship support to his Ph.D. student, Ms Anamika Singh, from his project was forwarded.

(f) Request by Kshitij Rai and others

The Convenor put forth the letter received from a group of M.Tech. students regarding mid-semester evaluation of their projects. The Chairperson emphasized that such issues do not fall within the purview of DRC. In cases where an evaluation committee member was absent during the process, the Head may kindly decide appropriately.

However, for evaluations from Sem I, 2018-19 it was recommended that all MTP students be uniformly evaluated by one or two committees.

(g) List of external examiners for evaluation of MTP Part II

In view of the request by MTP Coordinator to faculty members for suggestion of names to serve as potential external examiners for MTP evaluation the list was approved as per Annexure 5. Further addition of names will remain open for the same.

(h) In view of the unfortunate demise of Prof P K Roychoudhury it was decided Prof Z. Ahammad will be the sole supervisor for Ph.D. student, Ms Siddhi S. (2013BEZ8029), and MS(Res) student, Mr Anirban Kundu (2016BEY7505).

(i) The committee was informed that 3 seats have been sanctioned to the department under the Prime Minister Research Fellowship (PMRF) as per a notification received from Joint Registrar Academics.

The meeting ended with thanks to all members.

Shilpi Sharma  
Convenor, DRC

**Distribution**

All DRC members and other DBEB faculty (by email)

## Allotment of topics to students for MTP

Entry No.	Name	Project assigned	Supervisor
2014BB50001	Abhinav Shukla	Removal of ARG from secondary treated effluent	ZA
2014BB50013	Shubham Goel	Quantification of wastewater toxicity using microbial responses	TRS
2014BB50009	Nisha Bhatt	Nutrient removal through the hybrid aerobic/anaerobic reactor	TRS
2014BB50010	Paras Agarwal	Rules for designing CRISPR/Cas9 experiments with minimal off-target activity	DS
2014BB50002	Akash Kakanwar	On line monitoring of fluorescence for assessment of metabolic state in poly (3-hydroxybutyrate) production	AKS
2014BB50003	Ashim Garg	On line monitoring of fluorescence for assessment of metabolic state in plant cell cultivation	AKS
2014BB50011	S Kaushik Yadav	<i>Topic to be decided</i>	GPA
2014BB50015	Vineet Kumar	Functional analysis of degradation of complex dyes by laccase isoforms	SM
2014BB50012	Samarth	<i>Topic to be decided</i>	SN
2014BB50008	Neha Meena	Investigation of role of aryl alcohol oxidase in lignin degradation	SM
2014BB50005	Kanishk	Tethered bead assay to study torque generated by bacterial flagellar motor	RE
2013BB50011	Dhritiraj Das	Targeting IDH1 in cancer	RK
2013BB50033	Saqib Ansari	<i>Topic to be decided</i>	SN

**Short-listing criteria for Admission to Ph.D. Program in the Department**

The candidates must have first class (60% or 6.0/10 CGPA) in all examinations starting from 10+2 up to the qualifying exam and they must meet the following criteria based on their qualifying exam degree:

Qualifying exam	Acceptable majors	General Category	OBC (Non-creamy layer)	SC/ST & PD
B. Tech/B.E.	Biochemical Engineering, Chemical Engineering, Biotechnology, Industrial Biotechnology, Bioinformatics, Environmental Engineering, Pharmaceutical Biotechnology, Food Science & Engineering, Food Technology	(i) B.Tech 70% or 7.0/10 CGPA  (ii) Valid JRF or GATE score of min. 600 in Life Sciences or Biotechnology or Chemical Engg.	(i) B.Tech 70% or 7.0/10 CGPA  (ii) Valid JRF or GATE score of min. 550 in Life Sciences or Biotechnology or Chemical Engg.	(i) B.Tech 65% or 6.5/10 CGPA  (ii) Valid JRF or GATE score of min. 500 in Life Sciences or Biotechnology or Chemical Engg.
M. Tech / M.E / MS(R) or equivalent	Biochemical Engineering, Chemical Engineering, Biotechnology, Industrial Biotechnology, Bioinformatics, Environmental Engineering, Pharmaceutical Biotechnology, Food Science & Engineering, Food Technology	(i) M.Tech 65% or 6.5/10 CGPA  (ii) GATE score not required	(i) M.Tech 65% or 6.5/10 CGPA  (ii) GATE score not required	(i) M.Tech 60% or 6.0/10 CGPA  (ii) GATE score not required
M.Sc	Biochemistry, Biotechnology, Bioinformatics, Biophysics, Biosciences, Chemistry, Environmental Science, Genetics, Life Sciences, Microbiology	(i) M.Sc. 60% or 6.0/10 CGPA  (ii) GATE score 600 or valid JRF	(i) M.Sc. 60% or 6.0/10 CGPA  (ii) GATE score 550 or valid JRF	(i) M.Sc. 55% or CGPA 5.5/10  (ii) GATE score 500 or valid JRF

**For B.Tech graduates from IITs**

In respect of B.Techs from IITs graduating with a CGPA of 8.0 or above, the requirement of qualification through a national examination is waived off.

**For B.Tech students from Centrally Funded Technical Institutions (CFTI)**

Students from CFTIs (Centrally Funded Technical Institutions - IITs, NITs, IIITs, etc) having CPI/CGPA 7.00 (at 10.00 scale) at the end of 3rd year are also eligible for admission to PhD. The requirement of qualification through a national examination is waived off.

**Experience required for admission to part-time PhD. Program in DBEB**

S. No	Qualifications	Work Experience (post qualification)
1	M.E./M.Tech./M.S.(R) or equivalent	Nil
2	B.E./B.Tech./M.Sc. or equivalent, from CFTIs/Central Universities	1 year
3	B.E./B.Tech./M.Sc. or equivalent, and working in IIT Delhi* (Project or Regular) * <i>Through proper channel</i>	1 year
4	B.E./B.Tech./M.Sc. or equivalent, from institutions other than CFTIs/Central Universities	2 years

The minimum qualification for these candidates is the same as for full-time candidates, except that the requirement for qualifying in a national examination is waived off.

**Short-listing criteria for Admission to M.S.(Res) Program in the Department**

The candidates must have first class in all examinations starting from 10+2 up to the qualifying exam and they must meet the following criteria based on their qualifying exam degree.

<b>Qualifying exam</b>	<b>Acceptable majors</b>	<b>General Category</b>	<b>OBC (Non-creamy layer)</b>	<b>SC/ST &amp; PD</b>
B. Tech.	Biochemical Engineering, Chemical Engineering, Biotechnology, Industrial Biotechnology, Bioinformatics, Environmental Engineering, Pharmaceutical Biotechnology, Food Science and Engineering, Food Technology	(i) B.Tech 70% or 7.0/10 CGPA  (ii) GATE score of min. 600 in Life Sciences or Biotechnology or Chemical Engg.	(i) B.Tech 70% or 7.0/10 CGPA  (ii) GATE score of min. 550 in Life Sciences or Biotechnology or Chemical Engg	(i) B.Tech 65% or 6.5/10 CGPA  (ii) GATE score of min. 500 in Life Sciences or Biotechnology or Chemical Engg
M.Sc.	Biochemistry Biotechnology, Bioinformatics, Biophysics, Biosciences, Chemistry, Environmental Science, Genetics, Life Sciences, Microbiology	i) M.Sc. 60% or 6.0/10 CGPA  ii) GATE score of min. 600 in Life Sciences or Biotechnology or Chemical Engg.	i) M.Sc. 60% or 6.0/10 CGPA  ii) GATE score of min. 550 in Life Sciences or Biotechnology or Chemical Engg.	i) M.Sc. 55% or 5.5/10 CGPA  ii) GATE score of min. 500 in Life Sciences or Biotechnology or Chemical Engg.
B. Tech. (from IITs)	Biochemical Engineering / Chemical Engineering / Biotechnology / Food Engineering Technology/ Industrial Biotechnology	In respect of B.Techs from IITs graduating with a CGPA of 8.0 or above, the requirement of qualification through a national examination is waived off.		

**Department of Biochemical Engineering and Biotechnology**

**Recommendations on the Sub Committee of DRC formed for developing a new  
PhD Comprehensive Examination format**

April 15, 2018

The Sub-Committee held a few meetings and discussions to come up with the new format and syllabus for the PhD written comprehensive examination.

The Chairperson of DRC is requested to consider these recommendations for discussion in the ensuing DRC meeting scheduled for April 16, 2018 and for immediate implementation.



**D. Sundar**  
(on behalf of the Committee)

√ **Chairperson, DRC (DBEB)**

Sub Committee Members

Atul Narang, Ziauddin S. Ahammad, D. Sundar and Preeti Srivastava



## PhD Comprehensive Examination

All the PhD students of the department are required to take comprehensive examination one year after their joining. They are required to pass this exam to continue further research. Few guidelines on the modalities of the comprehensive examination procedure are described below.

- A student shall be formally registered/admitted to the candidacy of Ph.D. degree only after he/ she has cleared the comprehensive examination. Each student will be required to take a comprehensive examination which will test students' comprehension of his/her broad field of research and his/her academic preparation and potential to carry out the proposed research plan.
  - The comprehensive examination will have two components - (a) written test and (b) oral test.
  - Students would be permitted to take the written comprehensive examination only after they have completed the course work (including compulsory audit course - HUL 810 – Research writing).
  - Students would be permitted to take the oral comprehensive examination only after they pass the written comprehensive examination and subsequent submission of a research plan.
  - Full-time and part-time students must clear the written and oral comprehensive examination within a period of 18 months and 24 months, respectively, from the date of joining. A maximum of two chances will be given to any student to clear the comprehensive examination.
  - Every student, after having completed the comprehensive examination must formally register for the candidacy on a form obtainable from the Academics section (PG Section).
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### (A) Written Comprehensive Examination format

- The students admitted to Ph.D. program in the Department are required to take the Written Comprehensive Examination which will test students' comprehension of his/her broad field of research and his/her academic preparation and potential to carry out the proposed research plan.
- The written comprehensive examination will have two papers.

Paper	Expectation	Conduct of Exam
Paper 1	The purpose of this paper is to determine whether the student has the knowledge in the broad area of biochemical engineering and modern biotechnology	by DRC
Paper 2	The purpose of this paper is for the SRC concerned to determine the student's breadth of knowledge in proposed area of research	by respective SRCs

- Paper 1 would be common to all the PhD students of the department and Paper 2 will be separate for each student.
- The duration of the both the examination papers should be 180 minutes.
- Both the examination papers should have questions worth 100 marks.
- A minimum of 50% is required for passing in each paper.

#### Syllabus for written comprehensive exam papers

Paper 1 : The recommendations for the syllabus of this compulsory paper that is common to all PhD students is available in **Annexure 1**.

Paper 2 : The syllabus for this paper is to be formed by the respective SRCs and has to be approved by the DRC before the exam is conducted. The DRC has to keep a record of the syllabus being approved for each student who has joined the department.

#### Evaluation of Paper 1 written comprehensive exam paper

- Immediately following the examination, the evaluation of Paper 1 should be completed by the DRC members within a week's time and the DRC Chair must ensure the announcement of results of all the successful students.
- If all the students have fared well above the minimum required marks, the results for Paper 1 can be immediately announced and then later on ratified in the next DRC meeting. However, if there is a requirement for discussion of any student's performance, the results can be announced after the approval of DRC in its meeting.

#### Conduct and Evaluation of Paper 2 written comprehensive exam paper

- Students would be eligible to appear in Paper 2 exam after they have successfully passed in the Paper 1.
- The evaluation of Paper 2 must be completed by the respective SRC members and the Supervisor(s) must ensure that the exam paper/grading along with the question paper is submitted to the DRC for its approval within a week's time

#### Announcement of results of written comprehensive exam

- DRC must ensure a quick announcement of final results of successful students, who have completed the written comprehensive exam requirement and who have become eligible to appear in the oral comprehensive examination.

## **(B) Oral Comprehensive Examination format**

- The Oral Comprehensive Exam should be conducted by the student's SRC and should test the student's (1) capacity for logical thinking; (2) breadth of knowledge in proposed area of research; and (3) ability to develop and conduct the research that can lead to a good quality thesis completion.
  - Discussion of the proposed plan of research may serve as a vehicle for determining the student's general knowledge and research capacity. However, the SRC should ensure that the oral examination is not considered just as a defense of a specific research proposal or an update on the work carried out after joining in the PhD program.
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## **(C) Failure in the examination**

- If any student has failed in the written or oral examination, the DRC must ensure that it recommends a future course of action and not just leave it to the respective Supervisor or SRC.
  - The recommendation may be one of the following:
    - i). No re-examination (not successful after 2 attempts).
    - ii). Re-examination by the same SRC (in case of Paper 2 written exam or oral exam). DRC must ensure that a new member is appointed to join the SRC to conduct the re-examination.
    - iii). Re-examination by a new committee (in case of Paper 2 written exam or oral exam).
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## **(D) Recommended time-line for conduct of written and oral comprehensive exam**

<b>Sl.</b>	<b>Action</b>	<b>Time Period</b>	<b>Action</b>
1	Conduct of written comprehensive exam (Paper 1)	April 1/2 week / Nov 1/2 week	DRC
2	Announcement of results of written comprehensive exam (Paper 1)	April 2/3 week / Nov 2/3 week	DRC
3	Conduct and evaluation of written comprehensive exam (Paper 2)	May 1 <sup>st</sup> week / Dec 1 <sup>st</sup> week	SRC
4	Announcement of results of written comprehensive exam (Paper 2)	May 2 <sup>nd</sup> week / Dec 2 <sup>nd</sup> week	DRC
5	Conduct and evaluation of oral comprehensive exam	before 18 or 24 months of joining for full time and part time students respectively	SRC
6	Announcement of successful students who have completed the requirement of both written/oral comprehensive exam	Immediately following the receipt of oral examination report from SRC	DRC

## Annexure - 1

### Syllabus for Paper 1 Written Comprehensive Examination

Paper 1 is a compulsory paper for all PhD students of the department. This paper will have two parts – Section A (Bioprocess Engineering) and Section B (Biochemistry, Microbiology and Molecular Biology).

#### Section A

##### (Bioprocess Engineering)

#### **1. Bioreaction Engineering**

- a) Criteria for good mixing of gas, cells, and liquid, and the power required to achieve it.
- b) Scale-up
- c) Formulating steady and unsteady mass balances
- d) Mass transfer of oxygen: Theory and measurement of the mass transfer coefficient
- e) Modes of reactor operation: Batch, continuous, fed-batch, recycle, series
- f) Constructing elemental mass balances and testing consistency of data

##### Suggested books

- 1) Doran, P. M. Bioprocess Engineering Principles, ISBN 978-93-81269-83-1.
- 2) Shuler, M. L. and Kargi, F. Bioprocess Engineering: Basic Concepts, ISBN 978-81-203-2110-6
- 3) Villadsen, J., Nielsen, J., Liden, G. Bioreaction Engineering Principles, ISBN 978-1-4419-9687-9

#### **2. Bioseparation Engineering \***

- a) Filtration
- b) Centrifugation
- c) Cell disruption
- d) Extraction
- e) Adsorption
- f) Precipitation
- g) Ultrafiltration
- h) Chromatography
- i) Crystallization
- j) Drying

##### Suggested books

- 1) Belter, P. A., Cussler, E. L., Hu, Wei-Shu. Bioseparations: Downstream Processing For Biotechnology, ISBN 0-471-84737-2.
- 2) Harrison, R. G., Rudge, S. R., Petrides, D. P. Bioseparations Science and Engineering, ISBN 978-0195391817

**\* The module on 'Bioseparation Engineering' will be part of the exam only from 2018-entry batch onwards**

## Section B

### (Biochemistry, Microbiology and Molecular Biology)

#### 1. Biochemistry

- a) Biomolecules structure and function
- b) Carbohydrates (monosaccharides, disaccharides and common polysaccharides – starch and cellulose)
- c) Proteins – primary, secondary, tertiary & quaternary structures; glycoproteins
- d) Lipids
- e) Basic metabolic pathways (Glycolysis, TCA cycle, Glyoxalate cycle, Pentose Phosphate pathway).

#### 2. Microbiology

- a) Organization of prokaryotic and eukaryotic cells.
- b) Structure and function of organelles (mitochondria, endoplasmic reticulum, golgi bodies) of eukaryotic cells.
- c) Microbiological techniques

#### 3. Microbial Genetics and molecular biology

- a) Structure and function of nucleotides, DNA and RNAs.
- b) Manipulation of nucleic acids - basic tools and techniques
- c) Genes and genome complexity, organization of genomes, Molecular analysis of nucleic acid sequences

#### 4. Analytical Methods \* - Techniques such as Spectrometry, chromatography, electrophoresis

#### Suggested Books

- 1) Madigan, M.T, Martinko, J.M and Bender, K.S. Brock Biology of Microorganism, ISBN-13: 978-0321897398.
- 2) Berg, J.M, Tymoczko, J.L. and Stryer, L. Biochemistry, ISBN-13: 978-0716746843.
- 3) Willey, J.M., Sherwood, L., Woolverton, C.J., Prescott, L.M. Microbiology, ISBN 0072992913.
- 4) Freifelder, D., Cronan, J. and Maloy, S.R. Microbial Genetics, ISBN-13: 978-8173196973.
- 5) Brown, T.A. Genomes. ISBN-10: 0-471-25046-5
- 6) Mount, D. Bioinformatics: Sequence and Genome Analysis, ISBN-13: 978-0879697129.
- 7) Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology, ISBN-13: 978-0521178747.
- 8) Skoog, D.A., Hollder F.J and Crouch, S.R. Instrumental Analysis, ISBN-13: 978-8131505427.

**\* The module on 'Analytical Methods' will be part of the exam only from 2018-entry batch onwards**