Manav Rachna International Institute of Research and Studies

(Deemed to be university under section 3 of the UGC Act 1956)

CURRICULUM
AND
SCHEME OF EXAMINATION

B.TECH

BIOTECHNOLOGY

2021-2024

Faculty of Engineering & Technology
Department of Biotechnology
Faridabad-121006, Haryana.

FOREWORD

This is to certify that this booklet contains the entire Curriculum and Scheme of Examination of B. Tech Biotechnology being offered at Faculty of Engineering and Technology of this University. This has been duly vetted and finally approved by the Academic Council of the University vide agenda item 37.35.01 of 37th AC held on 2th July, 2021 and changes, if any deemed appropriate, shall be duly incorporated after the necessary approval by the Academic Council.

This Curriculum and Scheme of Examination of B. Tech Biotechnology shall be implemented w.e.f. AY 2021-22.

Prof. (Dr.) Naresh Grover
Date: **Dean-Academics, MRIIRS**

Preamble

The program B.Tech in Biotechnology is adapted to an outcome based education system which would enable the students to acquire the capabilities to meet the demands of society and industry at regional, national and global level. The Program Education Objectives (PEOs) of B.Tech in Biotechnology are consistent with the Vision and Mission of the Department as well as the University, and aim to produce globally successful biotechnologists who are empowered to contribute to nation building through sound knowledge, technical skills and research aptitude. The POs and PSOs address the PEOs and aim to produce innovators, scientists, entrepreneurs and technocrats with high professional and social ethics and who are aware about the socio-ethical implications of Biotechnology so that the products and processes related to the field can be utilized for the benefit of mankind.

The design of curriculum is done in accordance with the predetermined Program Education Objectives. The syllabus content of each course is meticulously created to develop thorough understanding and gain in-depth knowledge in the subject. A number of theory courses are accompanied with laboratory courses to inculcate the practical skills. In order to ensure the effectiveness of teaching-learning process and true implementation of the curriculum, the course outcomes of each course are developed to meet the program outcomes and program specific outcomes, which are also reflected in the Course Articulation Matrix. Course outcome and program outcome attainment is measured through direct and indirect tools including internal Evaluations, assignments, end semester examinations, dissertations and projects etc. The curriculum incorporates Choice based credit system (CBCS) in which the students are free to opt elective courses and earn credits.Under Elective Courses Basket, there are three types of credit based courses- Semester-wise courses offered by the department itself, Open/Inter-disciplinary courses offered at the Institute/University level notified from the office of Dean-Academics, and Massive Open Online Courses (MOOCs) available on SWAYAM Platform or any other platform as recommended by UGC/AICTE and notified from the office of Dean-Academics.

Although the curriculum had been designed after thorough deliberations involving experts from academia and industry, and considering the feedbacks obtained from various stakeholders, there is always a scope of regular revision and updation of the syllabus keeping in view the changing needs of the industry and society. Thus a well- articulated process is followed to revise the curriculum from time to time. The process begins with obtaining feedbacks from various stakeholders i.e. students, faculty, alumni, parents and industry experts. The feedbacks are analyzed and relevant suggestions are incorporated in the curriculum through a Curriculum revision workshop under the supervision of Departmental Academic Committee (DAC). The revised curriculum is scrutinized by the Board of Studies (BOS) and suggestions of the BOS are also incorporated. The revised curriculum is then placed before the Board of Faculty for consideration which is further reviewed and approved by the Academic Council.

The curriculum exhibits the requisite balance among the fundamental, core and elective subjects. This is to create a Biotechnology student talent pool that can serve the need of the Indian as well as global industry and also meet the local and regional needs. The curriculum includes courses focusing on employability, entrepreneurship and skill development which map strongly with the PO defining demonstration of technical knowledge and engagement in independent and life-long learning. Certain courses are meant to create awareness about the environment and sustainability and inculcate professional ethics so that all round development of students is ensured and they are transformed into entrepreneurs and professionals with high values and ethics.

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DEPARTMENT OF BIOTECHNOLOGY

VISION

Our vision is to produce competent biotechnologists who can employ premium processes and applications which will profoundly influence existing paradigm of agriculture, industry, healthcare and restoration of environment providing sustainable competitive edge to present society.

MISSION

- To provide Biotechnology educational program with impetus to generate quality workforce
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- To create awareness about potentials of Biotechnology with socio-ethical implications.

- To instill spirit of innovation and creativity in young minds with sound research aptitude.

- To nurture confident individuals who are effective contributors towards growth of the nation.

ABOUT THE DEPARTMENT

The Department of Biotechnology was set up in the year 2002 at ManavRachna campus. The department offers programmes at uder-graduate, post-graduate and doctoral levels, viz. B.Tech (4 Years), M.Tech (2 Years) and M.Sc (2 Years) in Biotechnology as well as PhD in Biotechnology and allied areas. Highly qualified teaching faculty with Doctoral and M.Tech qualifications in different areas of Biotechnology is the highlight of this Department. Faculty members and students of the Department have more than 250 publications in National and International journals of high repute including proceedings of seminars/ conferences.

The Department has a wide range of laboratories namely Cell Biology Lab, Microbiology Lab, Fermentation Technology Lab, Molecular Biology Lab, Environment Biotechnology Lab, Bioinformatics equipped with world class instrument facilities like HPLC, Atomic Absorption Spectroscopy, IR Spectroscopy, Fermenter, Gel Doc System, PCR, etc. A state-of art research level laboratory has been recently established as 'Molecular Biosciences Research Lab'. It is fully equipped with animal cell culture facility and houses major instruments like CO_2 incubator, fluorescence microscope, deep freezer, fume hood etc. This laboratory is meant for advanced research in molecular biology, animal biotechnology, enzyme technology and other allied areas. B.Tech Biotechnology offered by Department of Biotechnology has been accredited by NBA in the year 2018.

Department of Biotechnology has MoUs with industry and premium research organizations of India to facilitate academics and research and reinforce an environment of knowledge sharing and dissemination. The focus of these collaborations is to facilitate students and faculty in R&D, joint projects, trainings, utilizing high end instrumentation facilities. These organizations are-
1. Translational Health Science and Technology Institute (THSTI), Faridabad
2. ICAR-National Bureau of Plant Genetic Resources (NBPGR), New Delhi
3. National Institute of Immunology (NII), New Delhi
4. Indian Institute of Petroleum (IIP) Dehradun
5. Indian Oil Company Ltd. (IOCL), Faridabad
6. AdvanCells- Stem Cell Therapy, Noida

One of the biggest achievements of the Department of Biotechnology is the Startup Company-"TRICHO AGRONICA Pvt. Ltd. The Department of Biotechnology has developed a bioformulation 'Bioelixir' which is a completely organic remedy for Bull's eye pathogen causing early blight disease in tomato (*Lycopersiconesculentum* Mill.) crop. This Startup has been setup under Indian oil start up scheme (IOSUS), a "Start-up India" initiative and has been granted a funding of Rs.1.72 Crores.

The immense potential for placements in Biotechnology is evident from the success stories of alumni of the department. The pass out students of Biotech have bagged excellent placements in leading companies, viz, Agilent Technology, Covedien, Imperial Life Sciences, LifeCell International, Totipotent RX, Sagacious Research, CHC Health Care, e4e Health Group, Link Biotech, Ozone Biotech, CPM, Panacea Biotech, Medox Diagnostics, TCS (Biotech Division), Infosys (Biotech Division), IDS, L&T Infotech, IFBI and HCL, SCOTT EDIL & Kelly Services India Pvt. Ltd, Boston Scientific, etc.

Many pass outs have opted for higher studies in both national and International universities after qualifying in competitive exams. National institutes include IIT- Delhi, IIT- Kharagpur, IIT, Kanpur, IIT, Guwahati, NIT, Surthkal, NIT- Kurukshetra, VIT, Vellore, BITS- Pilani, BHU, Banaras and Anna University, Chennai etc. International institutions where the alumni of Biotech have pursued their higher education are University of Minnesota, USA, University of Buffalo, USA, University of Pennsylvania, USA, John Hopkins, USA, Nottingham Trent, UK, Sydney University, Australia, Arizona State Univ, USA, Baltimore Univ, USA, Florida Inst Of Tech, USA, WorcestorPolytech, USA, Imperial College - London, Monash Univ. Australia, University of Kuopio, Finland etc.

And the journey continues...

B.TECH IN BIOTECHNOLOGY

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

1. To make our students competent in the field of biotechnology and its allied areas.

2. To inculcate the capability to work as entrepreneurs and techno managers with strong ethics and communication skills.

3. To equip the students to pursue higher education and research in reputed institutes at national and international level.

4. To develop a working knowledge of biotechnology product and processes.

PROGRAMME OUTCOMES (PO)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
2. Identify and formulate research literature, and analyze engineering problems to arrive at substantiated conclusions using principles of mathematics, natural sciences and engineering sciences.
3. Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, the cultural, societal, and environmental considerations.
4. Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Create, select, and apply appropriate techniques, resources, modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
10. Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.
11. Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.
12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSO)

1. Acquire knowledge on the fundamentals of biotechnology for sound and solid base which enables to understand the emerging and advanced engineering concepts in life sciences.

2. Acquire knowledge in domain of biotechnology enabling their applications in industry and research.

3. Empower the students to acquire technologicalknowhow by connecting disciplinary and interdisciplinary aspects of biotechnology.

4. Recognize the importance of bioethics, IPR, entrepreneurship, communication and management skills so as to usher next generation of Indian industrialists.

MAPPING OF PEO WITH PO AND PSO

PEOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	3	1	3	2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	1	3	3	3	3	3	2	2	2	3	3	3	3	3	3

B.TECH IN BIOTECHNOLOGY

SEMESTER SYSTEM AND CHOICE BASED CREDIT SYSTEM

Credit based system of study and student's performance/progress is measured by the number of credits that he/she has earned, i.e. completed satisfactorily. Based on the course credits and grade obtained by the student, grade point average is calculated –

(a) Course credits assignment
Each course has a certain number of credits assigned to it depending upon its duration in periods for lecture, tutorial and laboratory/clinical practice in a week. A few courses/activities are without credit (s) and are referred to as Audit Pass Courses (APC) but are mandatory to pass as a partial fulfillment of award of degree.

(b) Earning of credits
At the end of every course, a letter "Grade" shall be awarded in each course for which a student has registered. On obtaining a minimum Pass Grade, student shall accumulate the course credits as Earned Credits. A student's performance shall be measured by the number of credits that he/she has earned and by the weighted grade point average. Grades obtained in the audit courses shall not be counted for computation of grade point average, however shall be mandatory to pass as a partial fulfillment of award of degree.
For Award of Degree of a programmeB.Tech in, he/she has to earn minimum**165 Credits** during the **4 year duration** of the programme in **8 semesters**.

The total credits required to be earned have been further classified under two baskets of courses: "Compulsory Courses Basket", and "Elective Courses Basket". The **total 126 credits** required to be earned under "Compulsory Courses Basket" and **39 credits** under "Elective Courses Basket".

All courses under "Compulsory Courses Basket", are required to be qualified and cleared/pass by each and every students enrolled under the programme and are semester-wise listed in the study scheme along with credits assigned to each course.
Under Elective Courses Basket, there will be three types of courses:
· Semester-wise courses offered by the department itself
· Open/Inter-disciplinary courses offered at the Institute/University level notified from the office of Dean-Academics.
· Massive Open Online Courses (MOOCs) available on SWAYAM Platform or any other platform as recommended by UGC/AICTE and notified from the office of Dean-Academics.

Each course shall have credits assigned to it. Student shall be required to register courses every semester for as many courses/credits specified under "Elective Courses Basket" depending upon his/her interest, capability/pace of learning and availability of time slot (without any clash in time table) so as to earn all required total credits under the "Elective Courses Basket" during the entire programme duration.

However, for registration of courses [including courses under "Compulsory Courses Basket", "Elective Courses Basket" and Previous Semester Courses (wherein he/she was declared in-eligible on the basis of attendance or he/she could not clear the course within permissible given chances)], if any, the maximum limit in a semester shall be 30 credits.

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
FACULTY OF ENGINEERING & TECHNOLOGY
STUDY SCHEME FOR FIRST YEAR B.TECH 2021-25 BATCH
SEMESTER-I
(Common for All B.Tech. Programmes) B.Tech (Non-CSE branches and CSE N): Group A & B.Tech CSE (SPL): Group B

Course Type	Subject Code	Title of Course	Pre-requisite Title	Pre-requisite Code	L	T	P	Total	Int./Continuous	End Sem.	Total	Duration of Exam	Credits
BSC	BPH-106	Physics for Engineers (Group A)	NA	NA	3+1#	0	0	4	100	100	200	3 hrs	3
BSC	BCH-106	Chemistry for Engineers (Group B)	NA	NA	2+1 #	0	0	3					2
BSC	BMA-101/ BMA-102/ BMA-103	Mathematics-I (For CSE only)/ Mathematics-1(All Branches except CSE & BT)/ Mathematics for Biotechnology-I (For BT only)	NA	NA	3+1#	1	0	5	100	100	200	3 hrs	4
ESC	BEE-101A	Basic Electrical Engineering (Group A)	NA	NA	3	0	0	3	100	100	200	3 hrs	3
ESC	BCS-101A	Programming for Problem Solving(Group B)	NA	NA									
ESC	BCS-100	AI for Engineers	NA	NA	2	0	0	2	100	100	200	3 hrs	2
ESC	BME-101A/ BME-102	Engg Graphics & Design(Group A)/ Workshop/Manufacturing Practices(Group B)	NA	NA	0	0	4	4	100	100	200	3 hrs	2
BSC	BPH-151A/ BCH-151A	Physics lab (Group A)/ Chemistry lab (Group B)	NA	NA	0	0	2	2	50	50	100	2 hrs	1
ESC	BEE-151A/ BCS-151A	Basic Electrical Engg lab (Group A)/ Programming for Problem Solving lab (Group B)	NA	NA	0	0	2	2	50	50	100	2 hrs	1
HSMC	BHM-201	English	NA	NA	2	0	0	2	50	50	100	2 hrs	2
HSMC	BHM-MC-001/ BCH-MC-002	Constitution of India* (Group A)/ EVS** (Group B)	NA	NA	1*	1**	0	1	50	50	100	2 hrs	AP
		Total (Group A/ Group B)							**700**	**700**	**1400**		**18/17**
		# Contact hours per week have been increased due to bridge course.											

SEMESTER-II

Course Type	Subject Code	Subject	Pre-requisite Title	Pre-requisite Code	L	T	P	Total	Int./Continuous	End Sem.	Total	Duration of Exam	Credits
BSC	BPH-106	Physics for Engineers (Group B)	NA	NA	3+1#	0	0	4	100	100	200	3 hrs	3
BSC	BCH-106	Chemistry for Engineers (Group A)	NA	NA	2+1 #	0	0	3					2
BSC	BMA-201/ BMA-202/ BMA-203	Mathematics-2 (For CSE only)/ Mathematics-2 (All Branches except CSE & BT)/ Mathematics for Biotechnology-II (For BT only)	NA	NA	3	1	0	4	100	100	200	3 hrs	4
ESC	BEE-101A	Basic Electrical Engineering (Group B)	NA	NA	3	0	0	3	100	100	200	3 hrs	3
ESC	BCS-101A	Programming for Problem Solving (Group A)	NA	NA									
ESC	BME-101A/ BME-102	Engg Graphics & Design(Group B)/ Workshop/Manufacturing Practices(Group A)	NA	NA	0	0	4	4	100	100	200	3 hrs	2
ESC	BBT-100	Biology for Engineers	NA	NA	2	0	0	2	100	100	200	3 hrs	2
BSC	BPH-151A/ BCH-151A	Chemistry lab (Group A)/ Physics lab (Group B)	NA	NA	0	0	2	2	50	50	100	2 hrs	1
ESC	BCS-151A/ BEE-151A	Programming for Problem Solving lab (Group A)/ Basic Electrical Engg lab(Group B)	NA	NA	0	0	2	2	50	50	100	2 hrs	1
HSMC	BHM-151	English lab	NA	NA	0	0	2	2	50	50	100	2 hrs	1
HSMC	BHM-MC-001/ BCH-MC-002	EVS** (Group A)/ Constitution of India* (Group B)	NA	NA	1*	1**	0	1	50	50	100	2 hrs	AP
		Total (Group A/ Group B)							**700**	**700**	**1400**		**16/17**
		# NOTE: Contact hours per week have been increased due to bridge course.											

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FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY
B.Tech - Biotechnology Batch 2021-25

SEMESTER- III													
Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Continuous Evaluation	End Semester Exam	Total		
Compulsory Courses													
CORE	BBT-DS-301	Cell Biology	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-302A	Microbiology	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-303	Biochemistry	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-304A	Bioanalytical Techniques	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-305	Bioinformatics & Computer Applications	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-351	Cell Biology Lab	NA	NA	0	0	2	2	50	50	100	3 hrs.	1
CORE	BBT-DS-352	Microbiology Lab	NA	NA	0	0	3	3	50	50	100	3 hrs.	1.5
CORE	BBT-DS-353	Biochemistry & Bioanalytical Techniques Lab	NA	NA	0	0	3	3	50	50	100	3 hrs.	1.5
CORE	BBT-DS-354A	Bioinformatics & Computer Applications Lab	NA	NA	0	0	2	2	50	50	100	3 hrs.	1
HSMC	BHM-320	Universal Human Values	NA		1	2	0	3	50	50	100	3Hrs	2
HSMC	DTI-300	Design, Thinking and Innovation – I	NIL		1	0	0	1	50		50		1
HSMC	BHM-MC-004	Quantitative Aptitude	NA	NA	0	0	2	2	50	50	100	2 hrs.	AP
PROJ	PROJ-BT-300	Summer Internship I	NA	NA	(minimum 4 weeks)			0	50	-	50	2 hrs.	1
Total					17	2	12	31	900	800	1700		24

SEMESTER-IV													
Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Continuous Evaluation	End Semester Exam	Total		
Compulsory Courses													
CORE	BBT-DS-401	Molecular Biology	Cell Biology	BBT-DS-301	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-402A	Immunology	Cell Biology	BBT-DS-301	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-403A	Fermentation Technology	Microbiology	BBT-DS-302A	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-404	Biostatistics	NA	NA	2	0	0	2	100	100	200	3 hrs.	2
CORE	BBT-DS-405	Biosafety, Bioethics & IPR	NA	NA	2	0	0	2	100	100	200	3 hrs.	2
CORE	BBT-DS-406	Engineering Economics	NA	NA	2	0	0	2	100	100	200	3 hrs.	2
CORE	BBT-DS-451	Molecular Biology Lab	Biochemistry & Bioanalytical Techniques Lab	BBT-DS-353	0	0	3	3	50	50	100	3 hrs.	1.5
CORE	BBT-DS-452	Immunology Lab	Biochemistry & Bioanalytical Techniques Lab	BBT-DS-353	0	0	2	2	50	50	100	3 hrs.	1
CORE	BBT-DS-453	Fermentation Technology Lab	Microbiology Lab	BBT-DS-352	0	0	3	3	50	50	100	3 hrs.	1.5
CORE	BBT-DS-454	Biostatistics Lab	NA	NA	0	0	2	2	50	50	100	3 hrs.	1
HSMC	DTI-400	Design, Thinking and Innovation – II	Design, Thinking and Innovation – I	DTI-300	1	0	0	1	50		50		1
HSMC	BHM-MC-002	Sports and Yoga	NIL		1	2	0	3	100		100	1 hr	AP
HSMC	BHM-MC-006	Quantitative Aptitude & Personality Development-I	NA	NA	0	0	2	2	50	50	100	2 hrs.	AP
Total					17	2	12	31	1000	850	1850		21

* Under Elective Courses, Inter-disciplinary, Generic, on-line Courses (MOOCs etc) and other approved courses shall be offered, which shall be notified well before start of the semester. The student shall be required and allowed to opt the courses out of offered courses as per prescribed limit for maximum credits in a semester and for the category of Elective Courses under University Rules.

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FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

B.Tech - Biotechnology Batch 2021-25

SEMESTER-V													
Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Continuous Evaluation	End Semester Exam	Total		
Compulsory Courses													
CORE	BBT-DS-501A	Recombinant DNA Technology	Molecular Biology	BBT-DS-401	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-502	Food Biotechnology	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-503	Animal Biotechnology	Cell Biology	BBT-DS-301	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-504	Entrepreneurship & Start-Ups	NA	NA	1	1	0	2	50	50	100	3 hrs.	2
CORE	BBT-DS-551A	Recombinant DNA Technology Lab	Molecular Biology Lab	BBT-DS-451	0	0	3	3	50	50	100	3 hrs.	1.5
CORE	BBT-DS-552	Food Technology Lab	NA	NA	0	0	3	3	50	50	100	3 hrs.	1.5
HSMC	BHM-520	Entrepreneurship and Startups	NIL		2	0	0	2	100	100	200	2 Hrs	2
HSMC	DTI-500	Design, Thinking and Innovation – III	Design, Thinking and Innovation – II	DTI-400	2			2	50		50		2
HSMC	BHM-MC-008	Quantitative Aptitude & Personality Development-II	NA	NA	0	0	2	2	50	50	100	2 hrs.	AP
PROJ	PROJ-BT-500	Summer Internship II	NA	NA	(minimum 4 weeks)			-	100	-	100	2 hrs.	2
Compulsory Generic Elective	HM-506 HM-507 HM-508	French I German I Spanish I	NA	NA	2	0	0	2	50	50	100	1.5 hrs.	2
		Total			16	1	8	25	800	650	1450		22
Program Elective Courses													
Domain Specific	BBT-DS-524	Biosimilars Technology	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-525	Genomics & Proteomics	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-526	Waste Water Treatment	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-527	Food Process Technology	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-528	Organic Agriculture	NA	NA	3	0	0	3	100	100	200	3 hrs.	3

SEMESTER-VI													
Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Continuous Evaluation	End Semester	Total		
Compulsory Courses													
CORE	BBT-DS-601	Plant Biotechnology	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-602	Environment Biotechnology	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-651	Cell & Tissue Culture Lab	NA	NA	0	0	3	3	50	50	100	3 hrs.	1.5
CORE	BBT-DS-652A	Environment Biotechnology Lab	NA	NA	0	0	3	3	50	50	100	3 hrs.	1.5
PROJ	PROJ-BT-600A	Minor Project	NA	NA	0	0	2	2	50	-	50	2 hrs.	1
HSMC	BHM-MC-009	Quantitative Aptitude & Personality Development-III	NA	NA	0	0	2	2	50	50	100	2 hrs.	AP
Compulsory Generic Elective	HM-606 HM-607 HM-608	French-II German-II Spanish-II	NA	NA	2	0	0	2	50	50	100	1.5 hrs.	2
		Total			8	0	10	18	450	400	850		12
Program Elective Courses													
Domain Specific	BBT-DS-624	Drug Delivery Systems	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-625	Molecular Diagnostics	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-626	Bioremediation & Biofuels	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-627	Food Biopackaging	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-628	Biofertilizers & Biopesticides	NA	NA	3	0	0	3	100	100	200	3 hrs.	3

* Under Elective Courses, beside the mentioned Program Elective Courses, other Inter-disciplinary, Generic, on-line Courses (MOOCs etc) and other approved courses shall be offered, which shall be notified well before start of the semester. The student shall be required and allowed to opt the courses out of offered courses as per prescribed limit for maximum credits in a semester and for the category of Elective Courses under University Rules.

Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Continuous	End Semester	Total		
			SEMESTER-VII										
			Compulsory Courses										
PROJ	PROJ-BT-701	Internship	NA	NA	24 Weeks (minimum 20 weeks)				600	300	900	3 hrs.	**10**
PROJ	PROJ-BT-702	Summer Internship III	NA	NA	(minimum 4 weeks)				100	-	100	2 hrs.	**2**
		Total							**700**	**300**	**1000**		**12**
			SEMESTER-VIII										
			Compulsory Courses										
CORE	BBT-DS-801	Stem Cell Technology	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-802	Precision Medicine & Wellness	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
CORE	BBT-DS-851	Precision Medicine & Wellness Lab	NA	NA	0	0	2	2	50	50	100	3 hrs.	1
PROJ	PROJ-BT-801	Major Project	NA	NA	0	0	5	5	200	100	300	3 hrs.	5
-	GP-BT-800	General Proficiency	NA	NA	0	0	2	2	-	100	100	3 hrs.	1
		Total			**6**	**0**	**9**	**15**	**450**	**450**	**900**		**13**
			Program Elective Courses										
Domain Specific	BBT-DS-824	Drug Discovery & Designing	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-825	Molecular Therapeutics	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-826	Green Biotechnology & Pollution Abatement	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-827	Nutraceuticals & Functional Foods	NA	NA	3	0	0	3	100	100	200	3 hrs.	3
Domain Specific	BBT-DS-828	Hydroponics & Aeroponics	NA	NA	3	0	0	3	100	100	200	3 hrs.	3

* Under Elective Courses, beside the mentioned Program Elective Courses, other Inter-disciplinary, Generic, on-line Courses (MOOCs etc) and other approved courses shall be offered, which shall be notified well before start of the semester. The student shall be required and allowed to opt the courses out of offered courses as per prescribed limit for maximum credits in a semester and for the category of Elective Courses under University Rules.

Sem- I & II	34
Swm III	24
Sem IV	21
Sem V	22
Sem VI	12
Sem VII	12
Sem VIII	13
TOTAL	**138**

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

MODULES FOR ELECTIVES - B. TECH IN BIOTECHNOLOGY Batch 2021-25

S.No.	Course Code	Subjects
MODULE 1: BIOPHARMACEUTICS	
1	BBT-DS-524	Biosimilars Technology
2	BBT-DS-624	Drug Delivery Systems
3	BBT-DS-824	Drug Discovery & Designing
	MODULE 2: MEDICAL BIOTECHNOLOGY	
S.No.		Subjects
1	BBT-DS-525	Genomics & Proteomics
2	BBT-DS-625	Molecular Diagnostics
3	BBT-DS-825	Molecular Therapeutics
	MODULE 3: ENVIRONMENT BIOTECHNOLOGY	
S.No.		Subjects
1	BBT-DS-526	Waste Water Treatment
2	BBT-DS-626	Bioremediation & Biofuels
3	BBT-DS-826	Green Biotechnology & Pollution Abatement
	MODULE 4: FOOD TECHNOLOGY	
S.No.		Subjects
1	BBT-DS-527	Food Process Technology
2	BBT-DS-627	Food Biopackaging
3	BBT-DS-827	Nutraceuticals & Functional Foods
	MODULE 5: Agriculture Biotechnology	
S.No.		Subjects
1	BBT-DS-528	Organic Agriculture
2	BBT-DS-628	Biofertilizers & Biopesticides
3	BBT-DS-828	Hydroponics & Aeroponics

Multi-disciplinary Courses offered by Department of Biotechnology	
1	Green BT & Pollution Abatement
2	IPR & Regulations
3	Bioinformatics & Computational Biology
4	Waste Management & Upcycling
5	Precision Medicine & Wellness

I Semester

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BPH-106: PHYSICS FOR ENGINEERS

Periods/week   Credits   Max. Marks   : 200
L: 3   T:0   3   Continuous Evaluation : 100
Duration of Examination: 3 Hrs   End Term Examination : 100

Pre-requisite: Basic knowledge of 10+2 level Physics
Course Type: Basic Sciences

Course Outcomes: The students will be able to:
BPH-106.1 discuss and explain the key concepts and principles of quantum physics, lasers and optical fibres
BPH-106.2 apply the basic concepts of semiconductors and devices based on them
BPH-106.3 analyze the structure, characterization techniques and applications of advanced material.
BPH-106.4 recall the basic concept of electromagnetism and understand their applications to the theoryof
          electromagnetic waves.

Unit-1 Lasers and Optical Fibres (8 Lectures)
Introduction to laser, Spontaneous and stimulated emissions of radiations, Einstein's coefficients and relation among them, Population inversion and laser pumping, Characteristics of lasers, Components of laser, He-Ne laser, Semiconductor laser, Applications of laser.
Introduction to optical fibres, Acceptance angle and acceptance cone, Numerical aperture, Classification of fibres, Attenuation, Losses associated with optical fibres, Merits and applications of optical fibres.

Unit-2 Quantum Physics (8 Lectures)
Limitations of classical physics, Black-body radiations, Planck's hypothesis, Photo-electric effect, Compton effect, Uncertainty principle, Matter waves, Phase and group velocity, Schrodinger's equations (time dependent and independent), Particle in a box (motion in one dimension), Basics of quantum statistics.

Unit-3 Semiconductors (8 Lectures)
Physical properties of semiconductors, direct and indirect band gap semiconductors, compound semiconductors, organic and inorganic semiconductors, Fermi level and Fermi energy, occupation probability, concentration of charge carriers, generation and recombination, carrier transport: drift and diffusion, energy band diagram of unbiased and biased P N Junction, Light Emitting Diode, Photodetectors - p-n photodiode, PIN, Photoconductivity, Effect of impurity & Traps, Photovoltaic effect and Solar cell.

UNIT 4: Advance Material and Synthesis (6 Lectures)
Introduction to nanomaterials, Nano-science and nano-technology, Two main approaches in nanotechnology, Bottom up technique, Top down technique, Quantum dot and graphene, Methods to produce Nanomaterials, Chemical vapour deposition, Sol-gel process, Molecular beam epitaxy, Physical and chemical properties of nanomaterials, Carbon nanotubes: single and multi-walled nanotubes, Synthesis of Nanotubes: carbon arc method, Laser evaporation method, Sputtering, applications of advanced materials.

UNIT 5: Investigating Techniques (6 Lectures)
Properties of X-Ray,Braggs' Law, Bragg's Spectrometer, Rutherford Back Scattering, Raman effect and Raman spectroscopy, Hall effect, Vander Pauw measurements for carrier density, resistivity, Hot-point probe measurement, AFM, SEM, photoluminescence spectroscopy, band gap by UV-Vis spectroscopy.

Unit-6 Electrodynamics (8 Lectures)
Divergence and curl of electrostatic field, Laplace's and Poisson's equations for electrostatic potential. Solutions of Laplace equation in one dimension, Dielectric Polarization and Dielectric constant, Piezoelectricity, Bio-Savart law and Ampere's circuital theorem, Continuity equation for current densities, Displacement current, Maxwell's equations, Electromagnetic energy − Flow of energy and Poynting vector, The wave equation; Plane electromagnetic waves in vacuum, their transverse nature, Energy carried by electromagnetic waves.

Text Books/ Reference Books:
1. P. Bhattacharya,2017, Semiconductor Optoelectronic Devices, Pearson education.
2. D.J Griffiths, 2015, Introduction to Electrodynamics, Pearson education.
3. Avadhanulu and Kshirsagar,2014, A textbook of Engineering Physics S. Chand.
4. S.P. Taneja,2018, Modern Physics for Engineers, R. Chand & Co.
5. Mark Ratner and Daniel Ratner, 2003,Nanotechnology, Pearson.
6. M.N.O. Sadiku, 2015, Elements of Electromagnetics, Asian Edition, Oxford Higher Education.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Assignments, Sessional and End Semester Examination paper will consist of various difficulty levels to accommodate the different capabilities of students. Assessment should cover all course outcomes and upper limit for lower order skills will be 40% (for knowledge-oriented questions). However, weightage for different cognitive levels in the question papers can vary.

Instructions for paper setting: The paper setter must ensure the coverage of entire syllabus while setting the question papers and mention the learning outcomes across each section to be measured by the examination. Weightage of the sections may vary as per the number of respective lecture hours mentioned in the syllabus. Action verbs should be used from Bloom's Taxonomy while designing question papers.

Course articulation Matrix

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3	PSO4
BPH-106.1	2	2	1	2	3	-	-	-	-	-	2	3	1	-	-	1
BPH-106.2	**3**	1	3	-	2	1	1	-	-	-	-	3	1	1	-	1
BPH-106.3	3	2	2	-	2	2	1	-	-	-	-	2	-	-	1	
BPH-106.4	3	3	3	1	1	3	1	-	-	-	-	3	1	-	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BMA-103: MATHEMATICS FOR BIOTECHNOLOGY- I

Periods/week   Credits
L: 3   T: 1   4
Duration of Examination: 3 Hrs

Max. Marks   : 200
Continuous Evaluation   : 100
End Semester Examination:100

Pre-requisites: knowledge of basic mathematical concepts of 10th standard.
Course Type: Basic Sciences.

Course outcomes:
The students will be able to
BMA-103.1   define the basic concepts of linear algebra, differentiation, integration, complex numbers and trigonometry.
BMA-103.2   apply the knowledge of linear algebra, complex numbers and trigonometry in engineering.
BMA-103.3   test the convergence of mathematical functions.
BMA-103.4   understand the concept of differential calculus of one variable.
BMA-103.5   use the concepts of differentiation of function of several variables.
BMA-103.6   solve maxima and minima of functions.

PART-A

Unit- 1: Matrices
Types of Matrices, Matrix Algebra, Determinants, Elementary transformation, Inverse of a matrix,
Rank of a matrix, Solution of simultaneous linear equations, Eigen values and Eigen vectors of a matrix, Applications of Cayley-Hamilton theorem.

Unit -2: Complex Numbers & Trigonometry
Complex numbers, Addition, Multiplication and Division of complex numbers, Polar form of complex number, De-moiver's theorem and its applications, Trigonometric functions and its graphs, Trigonometric ratios of compound, multiple and sub-multiple angles, Trigonometric equations, Inverse trigonometric equations.

Unit- 3: Infinite Series
Infinite Series, Tests for Convergence/Divergence: p-series test, Comparison test, D'Alembert ratio test, Cauchy's root test, Raabe's test, Logarithmic test, Alternating series: Absolute convergence and Conditional convergence.

PART-B

Unit -4: Differential Calculus-I
Limit, Continuity and Differentiability, Differentiation of simple functions, Properties of differentiation, Successive differentiation, Leibnitz's theorem, Expansion of function by using Taylor's and Maclaurin's theorem for a function of single variable.

Unit -5: Differential Calculus-II
Function of several variables, Partial derivatives, Euler's theorem on Homogenous functions, Composite function, Maxima and Minima of functions of two variables, Jacobians and their properties.

Unit -6: Integral Calculus
Integration of functions, Various types of integration, Integration by parts, Double Integrals, Triple Integrals.

Text / Reference Books:
1. G.B. Thomas and R.L. Finney, 2002,Calculus and Analytic geometry, 9th Edition, Pearson, Reprint.
2. Erwin kreyszig, 2006, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.

3. D. Poole, 2005, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole.
4. N.P. Bali and Manish Goyal, 2008, A text book of Engineering Mathematics, Laxmi Publications.
5. B.S. Grewal, 2010, Higher Engineering Mathematics, 36th Edition, Khanna Publishers.

Weblinks:
http://nptel.ac.in/courses/111108066/
http://nptel.ac.in/courses/111104092/
http://nptel.ac.in/courses/111104085/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMA-103)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BMA-103.1	3	3	1	2	1	--	--	--	--	--	--	--	--	--	--	--
BMA-103.2	3	3	1	2	1	--	--	--	--	--	--	--	--	--	--	--
BMA-103.3	3	3	2	3	2	--	--	--	--	--	--	--	--	--	--	--
BMA-103.4	2	2	1	2	2	--	--	--	--	--	--	--	--	--	--	--
BMA-103.5	3	3	2	2	1	--	--	--	--	--	--	--	--	--	--	--
BMA-103.6	2	2	1	2	1	--	--	--	--	--	--	--	--	--	--	--

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

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BEE-101A: BASIC ELECTRICAL ENGINEERING

Periods/week Credits	Max. Marks	: 200
L: 3 T: 3	ContinuousEvaluation	: 100
Duration of Examination: 3 Hours	End Semester Exam	: 100

Pre-requisites
Course Type: Engineering Science

Course Outcomes: After completion of this course the students will be able to

BEE-101A.1 understand the components of electrical network, low voltage electrical installation, earthing and working of batteries.

BEE-101A.2 apply the basic theorems and laws for solving both dc and ac networks.

BEE-101A.3 differentiatebetween single phase series and parallel circuits and three phase system.

BEE-101A.4 explain the construction and working of transformers, electrical machines and power converters

Unit 1: DC CIRCUITS (8 hours)

1.1 Electrical circuit elements (R, L and C), voltage and current sources,

1,2Kirchoff Voltage and Current Laws,

1.3 Analysis of simple circuits (two loops) with dc excitation ,

1.4 Superposition Theorem,

1.5 Thevenin's Theorem,

1.6 Norton's Theorem,

1.7 Time domain analysis of first order system- RL circuit,

1.8 Time domain analysis of first order system- RC circuit.

Unit 2: AC CIRCUITS (8 hours)

2.1 Single Phase-AC Generation,

2.2 Sinusoidal Waveform- peak value average and rms values

2.3 Phasor representation, L, C, RL, RC circuit

2.4 RLC Series Circuits

2.5 Power factor, Real power, Reactive power and Apparent power

2.6 RLC parallel circuits

2.7 Resonance

2.8 Three Phase Emf Generation, Delta and Star Connections

2.9 Voltage and current relation in star and delta connections

Unit 3: TRANSFORMERS (6 hours)

3.1Magnetic materials

3.2 BH characteristics,

3.3 Working Principle and Emf Equation of transformer,

3.4 Ideal and Practical transformer,

3.5 Equivalent circuit Losses in transformer,

3.6 Efficiency and regulation of transformer

3.7 Auto transformer

3.8 Three phase transformer connections.

Unit 4: DC MACHINES (5 hours)

4.1 Construction and working of DC motor,

4.2 Torque-speed characteristic and speed control of separately excited dc motor,

4.3 Construction and working of DC generator,

4.4 EMF equation of DC generator,

4.5 Introduction to power converters/power switching devices.

Unit 5: AC MACHINES (6 hours)
5.1 Generation of rotating magnetic fields,
5.2 Construction and working of a three-phase induction motor
5.3 Significance of torque-slip characteristic,
5.4 Loss components and efficiency of three phase induction motor
5.5 Starting and speed control of induction motor,
5.6 Single-phase induction motor working and types
5.7 Construction and working of synchronous generators.

Unit 6: ELECTRICAL INSTALLATIONS (6hours)
6.1Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB,
6.2 Types of Wires and Cables,
6.3 Earthing,
6.4 Types of Batteries, Important Characteristics for Batteries,
6.5 Elementary calculations for energy consumption,
6.6 Power factor improvement and battery backup.

Text Books/ Reference Books:
1. I. J. Nagrath, D. P. Kothari ,2007, Basic Electrical Engineering, TMH.
2. S. NathChakrabarti, C. K. Chanda , 2009, Basic Electrical Engineering, TMH,2009.
3. B. L. Thereja , 2005, Electrical Technology Vol.1, S Chand.
4. V. N. Mittal, Aravind Mittal, 2007, Basic Electrical Engineering,TMH 2007.
5. S N Singh , 2011, Basic Electrical Engineering, PHI.
6. D. C. Kulshreshtha , 2009, Basic Electrical Engineering, McGrawHill.
7. Leonard S Bobrow,2011,Fundamentals of Electrical Engineering, 2nd edition, Oxford University Press.
8. E. Hughes ,2010, Basic Electrical Engineering, Pearson.
9. S K Sahadev ,2015, Basic Electrical Engineering, Pearson India.

Software required/Weblinks
http://nptel.ac.in/courses/108105053/
https://nptel.ac.in/courses/108108076/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B. Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-101A.1	3	3	2	1	1	-	-	-	-	-	-	2	3	1	1	1
BEE-101A.2	3	3	3	1	1	-	-	-	-	-	-	2	3	1	1	1
BEE-101A.3	3	3	3	1	1	-	-	-	-	-	-	2	3	3	1	1
BEE-101A.4	3	3	3	1	1	-	-	-	-	-	-	2	3	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BCS-100 :ARTIFICIAL INTELLIGENCE FOR ENGINEERS

Periods/week	Credits		Max. Marks: 200
L :2 T: 0	2.0		Continuous Evaluation: 100
Duration of Exam: 3 Hrs			End Term Examination:100

Pre-Requisite: Basic Knowledge of Computers
Course Type: Engineering Science Course

Course Outcomes: The students will be able to-
BCS-100.1 Understandthe evolution and various approaches of AI
BCS-100.2 Familiarize with the role of data, data storage, processing, algorithm, visualization, regression, classification and clustering.
BCS-100.3 Identify the Natural Language Processing in designing AI models.
BCS-100.4 Illustrate the use of various concepts of neural network and its applications.
BCS-100.5 Recognize the applications of AI and its domains in real-life applications.

Unit 1: An overview to AI
    1.1 The evolution of AI to the present
    1.2 Various approaches to AI
    1.3 What should all engineers know about AI?
    1.4 Other emerging technologies
    1.5 AI and ethical concerns

Unit 2: Data & Algorithms
    2.1 History of Data
    2.2 Data Storage and Importance of Data and its Acquisition
    2.3 The Stages of data processing
    2.4 Data Visualization
    2.5 Regression, Prediction & Classification
    2.6 Clustering & Recommender Systems

Unit 3: Natural Language Processing
    3.1 Speech recognition
    3.2 Natural language understanding
    3.3 Natural language generation
    3.4 Chatbots
    3.5 Machine Translation

Unit 4: Artificial Neural Networks
    4.1 Deep Learning
    4.2 Recurrent Neural Networks
    4.3 Convolution Neural Networks
    4.4 The Universal Approximation Theorem
    4.5 Generative Adversarial Networks

Unit 5: Applications
    5.1 Image and face recognition
    5.2 Object recognition
    5.3 Speech Recognition besides Computer Vision
    5.4 Robots
    5.5 Applications

Text Books / Reference Books:

1. ElaineRich,KevinKnight,& Shivashankar BNair,Artificial Intelligence,Third Edition, McGrawHill.
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition, Pearson.
3. Deepika M, Vijay Cuddapah, Amitendra Srivastava, Srinivas Mahankali, AI & ML - Powering the Agents of Automation, BPB Publication
4. Lasse Rouhiainen, Artificial Intelligence: 101 Things You Must Know Today About Our Future.
5. Oliver Theobald, Machine Learning for Absolute Beginners, Second Edition,
6. John Paul Mueller, and Luca Massaron, Artificial Intelligence For Dummies

Software required/Weblinks:
https://onlinecourses.nptel.ac.in/noc21_ge20/preview
https://www.tutorialspoint.com/artificial_intelligence/index.htm
https://nptel.ac.in/courses/106/102/106102220/
https://nptel.ac.in/courses/106/105/106105158/https://www.tutorialspoint.com/artificial_intelligence/index.htm
https://www.youtube.com/watch?v=0rrDgBIP2gU&list=PL-JvKqQx2AtfQ8cGvKsFE7Tj2FvB1vCkd

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-100)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BCS-100.1	3	2	-	-	-	-	-	-	-	-	-	3	1	1	1	1
BCS-100.2	3	-	3	2	-	-	-	-	-	-	-	3	2	3	3	2
BCS-100.3	3	3	3	-	-	-	-	-	-	-	-	3	2	3	3	2
BCS-100.4	3	-	-	-	-	-	-	-	-	-	-	3	2	3	3	1
BCS-100.5	3	2	2	-	-	-	-	-	-	-	-	3	3	3	3	2

BME-101A: ENGINEERING GRAPHICS & DESIGN

Periods/week Credits   Max. Marks : 200
L: 0   T: 0 P: 4   2   Internal/Continuous Assessment : 100
Duration of Examination: 3 Hrs   End Semester Exam : 100

Prerequisites:
Course Type: Engineering Science Course
Course Coordinator / Co-Coordinator:

Course Outcomes:
After completion of this course the students will be able to
BME-101A.1   understand the role and importance of Engineering Graphics, design/drafting in cognitive development.
BME-101A.2   conceptualize engineering drawing and descriptive geometry to understand different components and machineries.
BME-101A.3   visualize objects with the help of engineering principles, projection theories including their applications to solve problems related to engineering and production.
BME-101A.4   develop capability of understanding engineering drawing problems and implementation of respective solution.
BME-101A.5   develop capability of selection of solutions for a given design problem.
BME-101A.6   develop of capability of designing a product or assembly with its various components with a systematic design approach

Theory (Detailed Content)
Traditional Engineering Graphics:
Principles o f Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles;Isometric Projection;Surface   Development;Perspective;Reading   a   Drawing;   SectionalViews;Dimensioning&Tolerances; TrueLength,Angle;intersection, Shortest Distance.
(**Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory**)

<div align="center">

Part-A

</div>

Unit 1: Introduction to Engineering Drawing, Orthographic Projections
Principles of Engineering Graphics and their significance, usage of drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales; Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;
Unit 2: Projections of Regular Solids & Sections and Sectional Views of Right Angular Solids
Inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).
Unit 3: Isometric Projections
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric
Views to Orthographic Views and Vice-versa, Conventions;
Theory (Detailed Content)
Computer Graphics
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)
(**Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory**)

<div align="center">

Part-B

</div>

Unit 4: Overview of Computer Graphics, Customization & CAD Drawing

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids; consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Unit 5: Annotations, layering, other functions

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models.Part editing and two-dimensional documentation of models.Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Unit 6: Demonstration of a simple team design project

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Text Books:
1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. (Corresponding set of) CAD Software Theory and User Manuals

Reference Books:
1. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
2. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

Weblinks:
https://nptel.ac.in/courses/112103019/
https://nptel.ac.in/courses/112104172/

Assessment Tools:
Surprise questions during lab/Class Performance
Term end examination/viva

Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BME-101A.1	2	1	1	1	1	2	1	2	1	1	2	3	3	3	2	2
BME-101A.2	2	2	3	1	1	2	2	2	2	2	3	2	3	2	2	3
BME-101A.3	2	2	2	2	2	1	2	1	3	2	2	2	3	2	1	2
BME-101A.4	3	3	2	3	2	1	2	2	1	1	2	1	3	2	2	3
BME-101A.5	3	3	2	3	2	1	2	1	1	1	2	1	3	2	2	3
BME-101A.6	2	1	3	2	3	2	2	2	3	2	2	1	3	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

NAAC 'A' Grade University
BPH-151A: PHYSICS LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Internal	: 50
Duration of Examination: 2 Hrs		External	: 50

Pre-requisite: Basic knowledge of 10+2 level Physics
Course Type: Basic Sciences Courses

Course Outcomes: The students will be able to:

BPH-151A.1 calculate zero error, least count, maximum percentage error, percentage error and understand their importance
BPH-151A.2 understand the principle, concept and working of the experiments
BPH-151A.3 rearrange/assemble the different components of a device or a circuit
BPH-151A.4 describe the methodology of science and the relationship between observation and theory

List of Experiments:
1. To calculate the hysteresis loss and magnetic susceptibility by tracingB- H curve.
2. To determine the value of Planck's constant h by a photo cell.
3. To determine the grating element of a given grating by using LASER.
4. To study Hall Effect in a semiconductor and to find (i) Hall voltage and Hall coefficient (ii) number of charge carriers per unit volume (iii) mobility.
5. To draw the characteristics of a solar cell and to find the fill factor.
6. To find the band gap of an intrinsic semiconductor using four probe method.
7. To draw the V-I characteristics of a PIN diode.
8. To determine numerical aperture of an optical fibre.
9. Todetermine the volume magnetic susceptibility of manganese sulphatesolution at different concentrations.
10. To find the charge to mass (e/m) ratio of an electron.
11. To study the resonance phenomena in LCR circuits.
12. To study the variation of magnetic field from Helmholtz coil.
13. To determine the moment of inertia of a flywheel.
14. To determine the Young's modulus of the material of a given beamsupported on two knife-edges and loaded at the middle point.
15. To determine the Modulus of Rigidity of a wire by Maxwell's Needle.

Text Books/References:
1. S. L. Gupta & V. Kumar, Practical Physics, 2018, Pragati Prakashan.
2. S.L. Arora, B.SC, Practical Physics, 2010, S. Chand.
3. NPTEL video lectures for Experimental Physics.

Instructions for Exam: One experiment out of 10 given randomly needs to be performed in exams.

Assessment Tools:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	20%

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PS O 4
BPH-151A.1	3	1		1				1	1	1		3	2	1		1
BPH-151A.2	2		2		2				1	1		2	1	1		
BPH-151A.3	2	3	2	3	3				3		1	3	2		2	1
BPH-151A.4	3	1	2		1		1	1	1	1		3	1	1		

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University
BEE-151A: BASIC ELECTRICAL ENGINEERING LAB

Periods/week   Credits
P: 2   1
Duration of Examination: 2 Hours

Max. Marks   : 100
Internal/Continuous Evaluation: 50
End Semester Exam   : 50

Course Outcomes
After completion of this course the students will be able to
  BEE-151A.1 familiarize with the measuring instruments, breadboard, CRO, components of LT installation
  BEE-151A.2 understand the transformers connection both single and three phase.
  BEE-151A.3 study the working principles of electric machines and power converters
  BEE-151A.4design a simple PCB with software.

LIST OF EXPERIMENTS:
   1. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors and verification of basic laws.
   2. To measure the steady-state and transient time-response of R-L/R-L circuits to a step change in voltage (transient may be observed on a storage oscilloscope).
   3. To examine sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage.
   4. To find the resonance frequency inR-L-C circuits..
   5. To observe the no-load current waveform of transformer on an oscilloscope (non- sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
   6. To perform Load test on a transformer: measurement of primary and secondary voltages and currents, and power.
   7. To connect Three-phase transformers in Star and Delta and verify voltage and current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side and to measure three-phase power in balanced three-phase circuits.
   8. Identification of various types of Printed Circuit Boards (PCB) and soldering techniques.
   9. Introduction to PCB design software.
   10. PCB Lab a) Artwork & printing of simple PCB b) Etching & drilling of PCB.
   11. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.
   12.To draw Torque -Speed Characteristic of dc motor.
   13. To find Synchronous speed of two and four-pole three-phase induction motors, check Direction reversal by change of phase-sequence of connections and to draw Torque-Slip Characteristic of an induction motor.
   14.To Study components of LT, switchgear- MCB, ELCB, MCCB.
   15. To Study DC-DC Converter.

Text Books:
Dr. N K Jain ,2010, A text book of Practicals in Electrical Engineering, Dhanpatrai Publishing Co.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

COURSE ARTICULATION MATRIX

CO Statement (BEE-151A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BEE-151A.1	3	3	2	1	1	-	-	-	-	-	-	2	3	1	1	1
BEE-151A.2	3	3	3	1	1	-	-	-	-	-	-	2	3	1	1	1
BEE-151A.3	3	3	3	1	1	-	-	-	-	-	-	2	3	3	1	1
BEE-151A.4	3	3	3	1	1	-	-	-	-	-	-	2	3	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
BHM 201: English

Periods/week   Credits   Max. Marks: 100
L: 2   T:0   P:0   2   Continuous Evaluation: 50
Duration of Exam: 2 Hours   External (Written): 50
Prerequisites:
Students are expected to have an inclination towards understanding the need for life skills required to succeed in their career and should know Basic English.

Course Type: Program Core

Course Outcomes: The students would be able to-
BHM 201.1.Speak in English confidently
BHM 201.2.Acquire proficiency in reading and writing skills
BHM 201.3.Communicate in grammatically correct English.
BHM 201.4.Create and deliver presentations confidently.
BHM 201.5 Understand the meaning of professional communication.

Unit 1. Vocabulary Building
1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form   derivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

Unit 2. Basic Writing Skills
2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

Unit 3. Identifying Common Errors in Writing
3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

Unit 4. Nature and Style of sensible Writing
4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

Unit 5. Writing Practices
5.1 Email Writing
5.2 Cover Letter
5.3 Essay

Unit 6. Oral Communication

6.1 Listening Comprehension
6.2 Pronunciation, Intonation, Stress and Rhythm
6.3 Common Everyday Situations: Conversations and Dialogues
6.4 Communication at Workplace
6.5 Interviews
6.6 Formal Presentations

Text Books/Reference Books:

- F.T. Wood.2007, Remedial English Grammar. Macmillan.
- William Zinsser,2001, On Writing Well, Harper Resource Book.
- Liz Hamp-Lyons and Ben Heasly. 2006, Study Writing. Cambridge University Press.
- Sanjay Kumar and PushpLata, 2011, Communication Skills. Oxford University Press.

Web links:

- https://www.mindtools.com/
- https://www.slideshare.net/
- http://ndl.iitkgp.ac.in
- hbx.hbs.edu

Distribution of Continuous Evaluation:

Sessional 1	15%
Sessional 2	15%
Assignment	10%
Class Performance	5%
Attendance	5%

Instructions for Paper Setting:

- **Section A- MCQ's- 30 marks**
- **Section B- 2 short questions- 10 marks**
- **Section C- 2 short questions, 10 marks**

Assessment Tools:

- **Assessment of sessional 1 through In Class Presentations.**
- **Continuous evaluation**
- **Assignments**
- **Attendance**
- **Marks for Behavior and soft skills displayed in the class**

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BHM 201.1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
BHM 201.2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1
BHM 201.3	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
BHM 201.4	-	-	-	-	-	-	-	-	2	-	1	-	-	-	1	1
BHM 201.5	-	-	-	-	-	-	-	1	1	-	2	-	-	-	1	1

BHM-MC-001: CONSTITUTION OF INDIA

Periods/week   Credits   Max. Marks   : 100
L :0   T: 1   AP   Continuous Evaluation: 50
Duration of Exam: 2 Hrs   End Semester Exam   : 50

Pre-Requisite: Nil
Course Type: HSMC

Unit-1: Background:
India's struggle for independence, Formation of the Constituent Assembly, The Union and its Territory : Nomenclature, Formation of New States and Alteration of Areas, Citizenship : Citizenship at the Commencement of the Constitution, Rights of Citizenship of certain persons, Rights of Citizenship of certain persons of Indian origin residing outside India, Continuance of the rights of Citizenship, Parliament to regulate the right of the Citizenship by law.

Unit-2: Fundamental Rights and Directive Principles :
Definition, Laws inconsistent with or in derogation of the Fundamental Rights, Equality before law, Prohibition of discrimination on grounds of religion, race, caste, sex or place of birth, Equality of opportunity in matters of public employment, Abolition of untouchability, Abolition of Titles- Right to Freedom, Right against Exploitation, Right to freedom of religion, Cultural and Educational rights, Right to constitutional remedies, Directive principles of State Policy : Definition, Right to work, Right to education and to public assistance in certain cases, provisions for just and humane condition of work and maternity relief, uniform civil code for the citizens, protection and improvement of environment and safeguarding of forests and wildlife, protection of monuments and places and objects of national importance, separation of judiciary from executive, promotion of international peace and security and Fundamental Duties.

Unit-3: The Union:
The executive, The President and Vice President of India, Council of Ministers, Attorney General for India, Parliament, Legislative procedure, The Union Judiciary: Establishment and constitution of Supreme Court, Powers and Functions of Supreme Court, Original Jurisdiction of the Supreme Court, The States : Definition, The Governor, Council of Ministers, The Advocate General for the State, The State Legislature, Legislative Procedure, High Courts in the State, The Union Territories, The Panchayats, Municipalities, Relations between the Union and the States.

Unit-4:Services under the Union and the States:
Services, Public Service Commissions, Elections: Election Commission of India, Emergency Provisions : Proclamation of Emergency, Amendment of the Constitution, Temporary, Transitional and Special Provisions, Schedules : First to Tenth Schedule and Miscellaneous.

Text books/reference books:
1. R. Bhargava, (2008) 'Introduction: Outline of a Political Theory of the Indian Constitution', in R. Bhargava (ed.) Politics and Ethics of the Indian Constitution, New Delhi: Oxford University Press, pp. 1-40.
2. G. Austin, (2000) 'The Social Revolution and the First Amendment', in Working a Democratic Constitution, New Delhi: Oxford University Press, pp. 69-98.
3. A. Sibal, (2010) 'From Niti to Nyaya,' Seminar, Issue 615, pp 28-34.
4. B. Shankar and V. Rodrigues, (2011) 'The Changing Conception of Representation: Issues, Concerns and Institutions', in The Indian Parliament: A Democracy at Work, New Delhi: Oxford University Press, pp. 105-173.
5. V. Hewitt and S. Rai, (2010) 'Parliament', in P. Mehta and N. Jayal (eds.) The Oxford Companion to Politics in India, New Delhi: Oxford University Press, pp. 28-42.
6. J. Manor, (2005) 'The Presidency', in D. Kapur and P. Mehta P. (eds.) Public Institutions in India, New Delhi: Oxford University Press, pp.105-127.
7. J. Manor, (1994) 'The Prime Minister and the President', in B. Dua and J. Manor (eds.) Nehru to the Nineties: The Changing Office of the Prime Minister in India, Vancouver: University of British Columbia Press, pp. 20-47.
8. U. Baxi, (2010) 'The Judiciary as a Resource for Indian Democracy', Seminar, Issue 615, pp. 61-67.
   R. Ramachandran, (2006) 'The Supreme Court and the Basic Structure Doctrine' in B. Kirpal et.al (eds.)

Supreme but not Infallible: Essays in Honour of the Supreme Court of India, New Delhi: Oxford University Press, pp. 107-133.

9. M. Singh, and R. Saxena (eds.), (2011) 'Towards Greater Federalization,' in Indian Politics: Constitutional Foundations and Institutional Functioning, Delhi: PHI Learning Private Ltd., pp. 166-195.

10. V. Marwah, (1995) 'Use and Abuse of Emergency Powers: The Indian Experience', in B. Arora and D. Verney (eds.) Multiple Identities in a Single State: Indian Federalism in a Comparative Perspective, Delhi: Konark, pp. 136-159.

11. B. Sharma, (2010) 'The 1990s: Great Expectations'; 'The 2000s: Disillusionment Unfathomable', in Unbroken History of Broken Promises: Indian State and Tribal People, Delhi: Freedom Press and Sahyog Pustak Kuteer, pp. 64-91.

12. P. deSouza, (2002) 'Decentralization and Local Government: The Second Wind of Democracy in India', in Z. Hasan, E. Sridharan and R. Sudarshan (eds.) India's Living Constitution: Ideas, Practices and Controversies, New Delhi: Permanent Black, pp. 370-404.

13. M. John, (2007) 'Women in Power? Gender, Caste and Politics of Local Urban Governance', in Economic and Political Weekly, Vol. 42(39), pp. 3986-3993

Distribution of Continuous evaluation table

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

2nd Semester

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University
BCH-106: CHEMISTRY FOR ENGINEERS

Periods/week	Credits	Max. Marks	: 200
L: 2 T: 0	2	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs		End Term Examination	: 100

Pre-requisite: Basic knowledge of 10+2 level Chemistry
Course Type: Basic Sciences

Course Outcomes: The course will enable the student to-
BCH-106.1. Apply fundamental principles to predict the structure, stereochemistry, bonding and general properties of materials.
BCH-106.2. Predict potential applications and practical utility of chemistry in different areas and propose suitable analytical techniques for practical applications.
BCH-106.3. Develop the understanding of water treatment techniques, electrochemical cells and combustion technology.

Unit 1: Water Treatment Chemistry (5 Lectures)
Impurities in water, Drinking Water quality standards, Hardness, types and its determination by EDTA method, Alkalinity and its determination, numerical problems based on hardness & alkalinity, Water softening methods: zeolite, ion-exchange process, Desalination of water: Reverse osmosis (RO) & Electro-dialysis process

Unit 2: Electrochemical cells and Fuels (5 Lectures)
Basic concepts of cells, Primary cells, Secondary cells and batteries, Fuel cells, Fuels and their types, Combustion technology

Unit 3: Phase Rule and its applications (4 Lectures)
3.1 Terminology of Gibb's phase rule and problems based on phase rule equation, One component system (water), Two component Eutectic system (Pb-Ag), Industrial applications of phase diagrams

Unit 4: Atomic and molecular structure (5 Lectures)
Limitations of classical mechanics in treating atomic and molecular phenomena, Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and nanoparticles, Molecular orbital treatment for homo-nuclear diatomic molecules, Bonding in Coordination Compounds: Crystal field theory

Unit-5: Stereochemistry (4 Lectures)
Structural isomers and stereoisomers, Representations of 3 dimensional structures, Enantiomers, diastereomers, Absolute configurations and conformational analysis

Unit6: Analytical Techniques(5 Lectures)
 Basic Principles of spectroscopy, UV- VIS spectroscopy and its applications, IR spectroscopy and its applications, Principle and analytical applications of Atomic Absorption spectroscopy, brief overview of Inductively coupled plasma mass spectrometry

Text Books/ Reference books/Web references:
1. P. C. Jain and Monica Jain, Engineering Chemistry, 2017, Dhanpat Rai Publishing Company.
2. Prasanta Rath, Subhendu Chakroborty, Chemistry, 2018, Cengage Learning Publishers.
3. B. H. Mahan,2010, University Chemistry, Pearson Education.
4. C. N. Banwell, 2008, Fundamentals of Molecular Spectroscopy, McGraw Hill Education India.
5. Gourkrishna Dasmohapatra, 2019, Chemistry-I, Vikas Publishing.
6. https://nptel.ac.in/courses/103/108/103108138/
7. https://nptel.ac.in/courses/122/101/122101001/

Distribution of Continuous Evaluation:

Sessional-I	30%
Sessional-II	30%
Assignment/Tutorial	20%
Class Work/ Quiz	20%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Assignments, Sessional and End Semester Examination paper will consist of various difficulty levels to accommodate the different capabilities of students. Assessment should cover all course outcomes and upper limit for lower order skills will be 40% (for knowledge-oriented questions). However, weightage for different cognitive levels in the question papers can vary.

Instructions for paper setting: The paper setter must ensure the coverage of entire syllabus while setting the question papers and mention the learning outcomes across each section to be measured by the examination. Weightage of the sections may vary as per the number of respective lecture hours mentioned in the syllabus.Action verbs should be used from Bloom's Taxonomy while designing question papers.

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O2	PS O3	PS O4
BCH-106.1	3	3	1	-	1	-	-	-	-	-	-	2	1	-	-	-
BCH-106.2	3	3	2	-	2	2	2	-	-	-	-	2	-	1	-	-
BCH-106.3	3	3	2	-	2	2	2	-	-	-	-	2	1	-	1	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

BMA-203: MATHEMATICS FOR BIO-TECHNOLOGY -II

Periods/week   Credits
L: 3   T: 1   4
Duration of Examination: 3 Hrs

Max. Marks   : 200
Internal   : 100
External   : 100

Pre-requisites: The students must have the knowledge of basic mathematical concepts of Matric leveland Mathematics for Bio-Technology- I.
Course Type: Basic Sciences.
 Course outcomes:
BMA-203.1   Students will be able to understand the phenomenon of real life problems encountered in engineering and its solution through differential equations.
BMA-203.2   Students will be able to evaluate differential equations of first order and first degree and its applications in engineering.
BMA-203.3   Students will be able to transform the given function from time to frequency domain.
BMA-203.4   Students will be able to carry out the concept of sine and cosine series expansions of function.
BMA-203.5   Students will be able to interpret the concepts of happening of events.
BMA-203.6   Students will be able to solve partial differential equations of first order and its applications in engineering.

PART-A
Unit 1: Differential equation of First Order and First Degree and its Applications
Introduction, order and degree, Solution of differential equations of first order and first degree: variable separable method, Homogeneous equation, Leibnitz equation, Exactdifferential equations, EquationsReducible to Exact differential equations.
Unit - 2: Higher Order Linear Differential Equations and its Applications.
Homogeneous Linear differential equations of nth order with constant coefficients, Complementary function and Particular integral, Simultaneous linear differential equations, Solution of second order differential equations by the method of variation of parameters, Euler-Cauchy equation, Legendre's linear differential equation.
Unit 3: Partial Differential Equation
Formation, Solution of Linear and Non-linear partial differential equation of first order, Solution of Non-linear partial differential equation by Charpit's method, Method of separation of variables for solving partial differential equations, Solution of one dimensional wave and heat conduction equation.

PART-B
Unit 4: Laplace Transform
Introduction, Laplace transforms of elementary functions, Properties of transform, Laplace transform of derivatives and integrals, Inverse Laplace transform of elementary functions, Properties of Inverse Laplace transform, Convolution theorem, Application to solve linear and simultaneous differential equations.
Unit 5: Fourier Series
Introduction, Periodic functions, Dirichlet's conditions, Fourier series of arbitrary periods, Euler's formulae, even and odd functions, Half range sine and cosine series.
Unit 6: Basics of Probability
Permutation and Combinations, Probability, Conditional probability, Random variable (Discrete and contitnuous), Baye's theorem.

Suggested Text/Reference Books:
1. Advanced Engineering Mathematics: H C Taneja, 2016, I K International, New Delhi.
2. A text Book of Engineering Mathematics Vol. I: H K Dass and Rama verma, 2010, S.Chand Publishing.
3. Advanced Engineering Mathematics: Jain R K and Iyenger S R K, 2007, Narosa Publishing House.
4. Higher Engineering Mathematics: B.S. Grewal,2013, Khanna Publishers.
5. Mathematics for class 11 & 12: R D Sharma, 2017, Dhanpat Rai Publication.
6. Engineering Mathematics Vol II: Babu Ram, 2012, Pearson Education.

7. Higher Engineering Mathematics: B. V. Ramana, 2006, TMG Hill Publishing Company Ltd.
8. Engineering Mathematics: Manish Gupta and N P Bali, 2008, Luxmi Publications, New Delhi.
9. Advanced Engineering Mathematics: Erwin Kreyszig, 2010, Wiley Eastern.

Weblinks:

http://nptel.ac.in/courses/111105090/
http://nptel.ac.in/courses/111106046/
http://nptel.ac.in/courses/111101004/
http://nptel.ac.in/courses/111107098/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix:

CO Statement (BMA-203)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BMA-203.1	3	3	1	2	1	--	--	--	--	--	--	--	--	--	--	--
BMA-203.2	3	3	1	2	1	--	--	--	--	--	--	--	--	--	--	--
BMA-203.3	3	3	2	3	2	--	--	--	--	--	--	--	--	--	--	--
BMA-203.4	2	2	1	2	2	--	--	--	--	--	--	--	--	--	--	--
BMA-203.5	3	3	2	2	1	--	--	--	--	--	--	--	--	--	--	--
BMA-203.6	2	2	1	2	1	--	--	--	--	--	--	--	--	--	--	--

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University
BCS-101A: PROGRAMMING FOR PROBLEM SOLVING

Periods/week Credits	Max. Marks : 200
L :3 T: 0 3.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Term Examination : 100

Pre-Requisite: Basic Knowledge of Computers
Course Type: Program Core
Course Outcomes: The students will be able to-
   BCS-101A.1 Formulate simple algorithms for arithmetic and logical problems with correct logic.
   BCS-101A.2 Implement the conditional statement and ietration with understanding of concepts.
   BCS-101A.3 Decompose a problem into functions and able to understand use of functions.
   BCS-101A.4Apply advance C programming techniques such as arrays, pointers, dynamic memory allocation, structures to develop solutions for particular problems.

PART- A
Unit-1: Introduction to Programming
1.1   Introduction to programming
1.2   Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)
1.3   Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/ Pseudo code with examples.
1.4   From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.
1.5   Expressions, Precedence and Associatively, Expression Evaluation, Type conversions

Unit-2: Loops and Conditional Statements
2.1   Arithmetic expressions and precedence
2.2   Conditional Branching; Writing and evaluation of conditionals and consequent branching
2.3   Iteration and loops

Unit-3: Arrays and Structures
3.1   Arrays (1-D, 2-D):1 D array and function–Passing individual array elements to a function, passing individual array elements address to a function, passing whole 1d array to a function, 2D array and function, Passing individual array elements to a function, passing individual array elements address to a function, passing whole 2d array to a function
3.2   Character Arrays and Strings
3.3   Structures; Defining Structures
3.4   Array of Structures
PART –B
Unit-4: Functions
4.1   Functions (including using built in libraries)
4.2   Parameter passing in functions
4.3   call by value.
4.4   Passing arrays to functions: idea of call by reference
4.5   Recursion, as a different way of solving problems.
4.6   Example programs, such as Finding Factorial, Fibonacci series.
Unit-5: Basic Algorithms
5.1   Iterative Searching (Linear and Binary Search)
5.2   Basic Sorting Algorithms with implementation (Bubble, Insertion and Selection)
5.3   Finding roots of equations
5.4   Notion of order of complexity through example programs (no formal definition required)

Unit-6: Pointers and File Handling

6.1   Idea of pointers, Defining pointers,Pointer to an array,Array of pointers,Pointers and two dimensional arrays
6.2   Use of Pointers in self-referential structures
6.3   Notion of linked list (no implementation)
6.4   File Handling :Working with text files and Binary Files,File operations using std. library and system calls–File management I/O functions

Text Books / Reference Books:
1. Byron Gottfried, 2015, Schaum's Outline of Programming with C: 2nd Ed., McGraw-Hill.
2. E. Balaguruswamy, 1998, Programming in ANSI C: 2nd Ed., Tata McGraw-Hill.
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language:, 2nd Ed., PHI.

Software required/Weblinks:
Turbo C
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-101A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BCS-101A.1	2	3	2	-	2	-	-	-	-	-	-	3	1	1	-	1
BCS-101A.2	2	1	2	1	3	-	-	-	-	-	-	-	-	1	1	2
BCS-101A.3	-	1	2	-	1	2	-	-	-	-	-	1	3	2	1	1
BCS-101A.4	3	3	1	3	2	-	-	-	-	-	-	-	3	1	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BME-102: WORKSHOP/MANUFACTURING PRACTICES

Periods/weekCredits
L: 0   T: 0P:4   2
Duration of Examination:3Hrs

Max. Marks :200
Continuous Assessment :100
End Semester Exam :100

Prerequisites: basic knowledge of Science and Mathematics Course
                    Type: Engineering Science Course

Course Outcomes:
After completion of this course the students will be able to
BME-102.1   Learn the basic manufacturing/fabrication processes and develop skills to fabricate with their own hand.
BME-102.2   Understand how to operate various traditional and modern machine tools used inindustries.
BME-102.3   Apply knowledge of the dimensional accuracies and dimensional tolerances, basics of various measuring instruments, hand tools and cuttingtools.
BME-102.4   Acquire knowledge of safetymeasurements
BME-102.5   Understand the impact of manufacturing engineering solution.
BME-102.6   Assemble different mechanicalcomponent/parts

Lectures & Videos (10 Hrs)

(i) Detailed Content

1.   Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3lectures).
2.   CNC machining, Additive manufacturing (1lecture)
3.   Fitting operations & power tools (1lecture)
4.   Electrical &Electronics (1lecture)
5.   Carpentry (1lecture)
6.   Plastic moulding, glass cutting (1lecture)
7.   Metal casting (1lecture)
8.   Welding (arc welding & gas welding), brazing (1lecture)

(ii) Workshop Practice: (60hours)

1.   Machine shop (10hours)
2.   Fitting shop (8hours)
3.   Carpentry (6 hours)
4.   Electrical & Electronics (8 hours)
5.   Welding shop (8 hours) (Arc welding 4 hrs + gas welding 4hrs)
6.   Casting (8hours)
7.   Smithy (6hours)
8.   Plastic moulding & Glass Cutting (6hours)

Students Project Fabrication

Students have to fabricate product from the assigned list with their own hands. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different workshop processes. The final product should be assembly of different components fabricated by different workshop practices.

For e.g. Tack-hammer; Project Display Stand; Pen stand, Screw Driver, Variable size Spanner, Electrical Extension Board with electronic circuits or any other product which should involve multiple workshop practices to fabricate a single product.

Each student will be issued the drawings of the product assembly along with the drawing of the sub-part assembly, mentioning the dimensions, tolerance, sub-products used.

Students should follow the process planning sheet of the product and get involved in different workshop practices to complete the jobs for final submission.

Note: Each student should do more than one product to get hands on experience of all the workshop practices.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop ", Technology Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited,Mumbai.

2. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology 4th edition, Pearson Education India Edition,2002.

3. Gowri P. Hariharan and A. Suresh Babu, Manufacturing Technology " I Pearson Education, 2008.

Reference Books:

1. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998.
2. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw Hill House, 2017.

Weblinks:

https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-me21/

Instructions for setting of Paper Seven questions are to set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each part A and part B (one from each unit). Student needs to attempt two questions out of three questions from each part. Each question will be of 20 marks.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BME-102.1	3	3	3	3	2	1	1	2	2	2	2	3	3	3	3	3
BME-102.2	3	3	3	3	3	2	1	2	2	2	2	2	2	2	2	2
BME-102.3	3	3	3	3	3	2	2	1	2	2	1	2	2	2	2	2
BME-102.4	2	2	2	2	3	2	1	1	2	1	2	2	3	2	2	2
BME-102.5	3	2	2	2	2	3	3	2	2	2	2	2	3	2	2	2
BME-102.6	3	3	3	2	2	1	2	2	2	3	2	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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BBT-100: BIOLOGY FOR ENGINEERS

Periods/week Credits | Max. Marks : 200
L: 2   T: 0   P:0   02 | Continuous Evaluation : 100
Duration of Examination: 3 Hrs | End Semester Examination:100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Basic Sciences

Course Outcomes:
The students will be able to-

BBT-100.1 describe the taxonomic diversity of life forms and their functions.
BBT-100.2 assess the role of biomolecules in physiology and genetics.
BBT-100.3 illustrate the structural and functional organization of the human body.
BBT-100.4 apply the principles of biology for sustenance.

PART-A

Unit 1: The Living World
1.1 What is living World?
1.2 Diversity in the living world
1.3 Taxonomy and Biological Classification
1.4 Structural organization in plants and animals
1.5 Cell- The unit of Life

Unit 2: Microbiology
2.1 Microbial diversity, Ecology and Population dynamics, Microbial growth on surfaces Environmental effect on microbial growth.
2.2 Bioremediation, examples of bioremediation, Acid mine drainage, Enhanced metal recovery, Wastewater microbiology
2.3 Solid waste microbiology, Landfills, Leachate, Anaerobic degradation phases.
2.4 Antimicrobial resistance

PART-B

Unit 3: Biochemistry
3.1 Carbohydrates- monosaccharides, disaccharides and Polysaccharides,
3.2 Lipids- fatty acids, fats and oils, lipids of biological importance
3.3 Amino acids – essential and non-essential amino acids, peptide bond formation
3.4 Proteins- overview of proteins synthesis, structural organization, functions of proteins
3.5 Nucleic acids- structure and functions of DNA and RNA.
3.6 Enzymes: role as biological catalysts,Mechanism of enzyme action, Industrial applications of enzymes

Unit 4: Human Anatomy
4.1 General Anatomy- Basic terms in anatomy- Anterior, posterior, lateral, medial, Elementary tissues of the human body
4.2 Cardiovascular system, Respiratory System
4.3 Gastrointestinal System, Genito-urinary system
4.4 Musculoskeletal system, Nervous system& Sense organs

4.5 Endocrine System

Unit 5: Human Physiology
5.1 Body fluids and salts, composition and functions of blood, Blood groups, blood clotting
5.2 Cardiac cycle and heart sounds, Electrocardiogram (ECG), Blood pressure, Hypertension, Hypotension, Arteriosclerosis, Atherosclerosis, Angina, Myocardial infarction, Congestive heart failure and cardiac arrhythmias
5.3 Respiratory volumes and capacities, Hypoxia, Asphyxia
5.4 Disorders of GIT, Endocrine disorders
5.5 Microbial infections, Cancer

Unit 6: Genetics & Computational Approach to Biology
6.1 Genetics- DNA as a blueprint and RNA as a messenger, from DNA sequence to Genes (From alphabets to words), Mendelian Inheritance
6.2 DNA to Chromosomes- Genes and Mutations, Information pathways – Replication, Transcription and Translation, Epigenetic Modifications.
6.3 Computational Approach to Biology- Finding a needle in the haystack – Making sense of the Big Data,Types of Biological Datasets.
6.4 The "Omics" Approach, Introduction to Network Biology - Basics of Graph and Network Theory, Cellular Networks.

Text/ Reference Books:
1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wileyand Sons
3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freemanand Company
4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman andcompany, Distributed by Satish Kumar Jain for CBS Publisher
5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.Brown Publishers.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering the entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Students need to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-100.1	-	-	1	-	-	1	1	-	-	-	3	1	1	2	1	-
BBT-100.2	2	2	1	2	2	2	2	-	-	-	3	3	3	3	2	-
BBT-100.3	3	3	2	2	2	3	1	-	-	-	2	3	3	3	2	-
BBT-100.4	3	3	3	2	-	3	3	-	-	-	3	3	3	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUE OF RESEARCH & STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

NAAC 'A' Grade University

BCH-151A: CHEMISTRY LAB

Periods/week   Credits

P: 2   1

Duration of Examination: 2 Hrs

Max. Marks   : 100

Continuous Evaluation   : 50

End Term Examination : 50

Pre-requisite: Basic knowledge of 10+2 level Chemistry
Course Type: Basic Sciences Courses

Course Outcomes: The students will be able to:

BCH-151A.1. analyze the need and utility of the experiments.

BCH-151A.2. do precise quantitative measurements using volumetric glassware, analytical balance, and prepare standards solutions independently.

BCH-151A.3. carry out experiments to check the hardness, alkalinity and chloride content of different water samples and interpret the results.

BCH-151A.4. employ the basic methods/techniques to measure surface tension, viscosity, conductance, emf, saponification value of different samples.

List of Experiments:

1. Preparation and standardization of volumetric solutions.
2. Determination of viscosity using Ostwald Viscometer.
3. Determination of hardness of water by EDTA method.
4. Determination of alkalinity of water.
5. Determination of strength of solution by Conductometric titration.
6. Determination of Ferrous ion concentration using Potentiometer.
7. Determine the percentage composition of given mixture of sodium hydroxide and sodium chloride.
8. Determination of viscosity of lubricating oils using Redwood viscometers.
9. Determination of chloride content of water.
10. Determination of surface tension using Stalagmometer.
11. Determination of saponification value of oils.
12. Determination of the partition coefficient of a substance between two immiscible liquids.

Text Books/ Reference books/Web references:

1, Sunita Rattan, 2011, **Experiments in Applied Chemistry**, S.K.Kataria & sons.

2. Shailendra K.Sinha,2014, Physical Chemistry A Laboratory Manual, Alpha Science International Limited.

3. https://vlab.amrita.edu/index.php?sub=2&brch=190

4.https://vlab.amrita.edu/index.php?sub=2&brch=193&sim=575&cnt=1

Instructions for Exam: One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%

File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
BCH-151A.1	3	3	2	1	1	-	1	1	1	1	-	2	2	1	2	1
BCH-151A.2	3	3	2	1	2	-	1	1	1	1	-	2	2	-	1	-
BCH-151A.3	3	3	2	1	2	-	2	1	1	1	-	2	2	1	-	2
BCH-151A.4	3	3	2	1	1	-	1	1	1	1	-	2	2	1	1	1

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Periods/week	Credits	Max. Marks	:100
P :2	1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Term Examination	: 50

Co-Requisite: Programming for problem solving (BCS-101A)
Course Type: Program Core

Course Outcomes: Students will be able to-
  BCS-151A.1 Formulate the algorithms for simple problems in C language.
  BCS-151A.2 Understanding of syntax errors as reported by the compilers as well as logical errors.
  BCS-151A.3 Write iterative as well as recursive programs,implementing of arrays, strings andstructures
          and various graph traversing algorithms.
  BCS-101A.4 Declare pointers of different types and able to understand the concept of filehandling.

NOTE: The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm
to be implemented for the problem given.

List of Practicals:
Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value,call by refrence
Lab 7: Simple functions
Tutorial 8: Recursion, structure of recursive calls
Lab 8: Recursive functions
Tutorial 9: Numerical methods (Root finding, numerical differentiation, numerical
integration):
Lab 9: Programming for solving Numerical methods problems
Tutorial 10: Pointers, structures and dynamic memory allocation
Lab 10: Pointers and structures
Tutorial 11: File handling
Lab 11: File operations

Software required/Weblinks:
Turbo C
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Note: At least 5 more exercises to be given by the teacher concerned.

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

COURSE ARTICULATION MATRIX :

CO Statement (BCS-151A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BCS-151A.1	2	1	2	2	-	-	-	-	-	-	2	1	2	-	1	1
BCS-151A.2	3	-	-	3	2	-	-	-	-	-	-	-	2	3	3	2
BCS-151A.3	3	1	2	3	-	1	-	-	-	-	-	-	1	2	-	-
BCS-151A.4	2	3	1	2	3	-	-	-	-	-	1	1	3	2	-	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BHM-151: ENGLISH LAB
(Humanities and Social Sciences including Management Courses)

Periods/week   Credits
L: 0   T:0   P:2   1

Max. Marks   : 50
Continuous Evaluation: 25
End Semester Exam (Written)   : 25

Prerequisites:
Basic knowledge of English language

Course Type: Program Core

Course Outcomes:

BHM-151.1. Students would be able to speak in English confidently.
BHM-151.2. To develop the understanding of correct pronunciation and intonation.
BHM-151.3. Students would be able to communicate professionally in a corporate environment.

List of Activities

1. Listening exercises for correct pronunciation and intonation
2. Role plays for speaking confidently
3. Group Discussions
4. Extempore
5. Mock Interviews
6. In Class Presentations
7. JAM Sessions
8. Theatre activity

Text Books/Reference Books:
- Liz Hamp-Lyons and Ben Heasly. 2006, Study Writing. Cambridge University Press.
- Sanjay Kumar and PushpLata 2011, Communication Skills, Oxford University Press.
- CIEFL, Hyderabad ,Exercises in Spoken English. Parts. I-III, Oxford University Press.

Distribution of Continuous evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
BHM-151.1	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1
BHM-151.2	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-	-
BHM-151.3	-	-	-	-	-	-	-	1	1	-	2	-	-	1	1	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BCH-MC-002: ENVIRONMENTAL SCIENCE

Periods/week   **Max. Marks : 100**
       T: 1   Internal : 50
External : 50

Pre-requisite: Basic knowledge of Environment related issues
Course Type: Mandatory

Course Outcomes : The students will be able to

BCH-MC-002.1: comprehend various environmental issues through various activities.
BCH-MC-002.2: understand that each and every action of ours reflects on the environment and collaborate in groups to suggest innovative ways to protect environment through project work/report writing.

Activities:
i) Small group meetings about conservation and management of natural resources, conservation of biodiversity, solid waste management and *environmental remediation*
ii) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
iii) Expert talk
iv) Slogan writing /Poster making event
v) Cycle rally to create awareness on issues like pollution control, cleanliness, and waste management.
vi) Plantation activity
vii) Cleanliness drive
viii) Drive for segregation of waste
ix) Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
x) Environment protection related efforts

The break-up for marks
Internal Marks
Evaluation based on participation in activities: 50 marks
External Marks
Field work, Report writing & Viva: 20+20+10 = 50 marks

Course Articulation Matrix

CO Statement (BCH-MC-002)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BCH-MC-002.1	1	2	1	-	-	2	3	2	1	-	-	1	1	-	1	-
BCH-MC-002.2	1	2	1	-	-	2	3	2	1	-	-	1	1	-	1	-

3rd SEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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BBT-DS-301: CELL BIOLOGY

Periods/week   Credits
L: 3   T: 0   3
Duration of Ext. Exam: 3 Hrs

Max. Marks   : 200
Continuous Evaluation   : 100
End Semester Examination: 100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-301.1   describe the ultra-structure and composition of cell organelles.
BBT-DS-301.2   distinguish the functions of different cell organelles and interpret their physiological role.
BBT-DS-301.3   Discover the dynamic nature of cellular membranes and assimilate various events in cell cycle and its regulation.
BBT-DS-301.4   Apprise the mechanism of cell communication, muscle contraction and nerve transmission

PART-A

Unit 1: Cell Membrane and Permeability
1.1 Brief History of Structural Studies,
1.2 Membrane Proteins and Lipids,
1.3 Concept of Fluidity,
1.4 Dynamic Nature of membrane
1.5 Transport of Nutrients

Unit 2: Ultra Structure of Cytoplasm-I
2.1 Cytoskeleton- intermediate filament, microtubules, microfilaments
2.2 Endoplasmic Reticulum- structure and functions, role in protein segregation
2.3 Golgi complex – structure, biogenesis and role in protein secretion
2.4 Lysosomes - structure and function
2.5 Vacuoles- structure and function
2.6 Microbodies- structure and function

Unit 3: Ultra Structure of Cytoplasm -II
3.1 Ribosomes - structure and function, role in protein synthesis
3.2 Mitochondria- structure, biogenesis and genomes
3.3 Chloroplast – structure, biogenesis and genomes
3.4 Nucleus- structure and function
3.5 Cell Cycle and its regulation

PART-B
Unit 4: Cell Signaling and Communication
4.1 G protein linked receptors
4.2 Enzyme linked Cell surface receptor
4.3 Kinase receptors
4.4 Second messengers

4.5 Hormone receptors interaction
4.6 Convergence and divergence
4.7 Crosstalk among different signaling pathway
4.8 Calcium and NO as intracellular messenger

Unit 5: Cell interaction
5.1 Cell Junctions
5.2 Cell Adhesion
5.3 Extracellular matrix
5.4 Reception –integrin
5.5 Apoptosis

Unit 6: Muscle and Nerve Cell Mechanisms
6.1 Muscle- structural proteins of muscles, energetics and regulation of muscle contraction
6.2 Neurons- structure of neurons, resting potential, action potential and synaptic transmission
6.3 Neurotransmitters and receptors
6.4 The generation of action potential by sensory stimuli
6.5 Mechanisms of nerve impulse
6.6 Patch clamp technique

Text Books/ Reference Books:
1. Sadava, 2009, Cell Biology, Jones and Bartlett Publication.
2. De Robertes, 2017, Cell and Molecular Biology, Panima Publication
3. Albert, 2015, Essential of Cell Biology, Garland Publication
4. Cooper, 2016, The Cell: A Molecular Approach, ASM Press Publication, (2015), 7th Ed.

Web links:
http://nptel.ac.in/courses/102103012/
http://nptel.ac.in/courses/102103012/8
http://nptel.ac.in/courses/102106025/29
http://nptel.ac.in/courses/102106025/1

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-301)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-301.1	-	3	1	2	3	2	-	-	-	-	-	2	3	2	2	-
BBT-DS-301.2	1	2	-	3	2	-	-	-	-	-	3	3	3	2	1	-
BBT-DS-301.3	1	3	1	2	2	-	-	-	-	1	2	1	3	2	2	-

BBT-DS-301.4	3	3	1	2	2	2	1	-	2	2	3	2	3	2	2	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-302: MICROBIOLOGY

Periods/week   Credits
L: 3   T: 0   3
Duration of Ext. Exam: 3 Hrs

Max. Marks   : 200
Continuous Evaluation: 100
End Semester Examination:100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-302A.1 identify the diversity of microbes and recognize their role in ecosystems.
BBT-DS-302A.2 explain the theoretical basis of the tools, technologies and methods common to microbiology.
BBT-DS-302A.3 relate the processes used by microorganisms for their growth,metabolism, replication, recombination, survival, and interaction with their environment, hosts, and host populations.
BBT-DS-302A.4 formulate the strategies for control of microorganisms leading to laboratory contamination, infectious diseases and food spoilage.

PART-A

Unit 1: Introduction to Microbiology
1.1   Scope and brief history of microbiology
1.2   Introduction to microbial taxonomy
1.3   Systems of classification- Haeckel's three kingdom concept and Whittaker's five kingdom classification
1.4   Microbial phylogenetic groups
1.5   Bergey's manual
1.6   Criteria for classification including molecular approaches.

Unit 2: Microbial Diversity
2.1 Prokaryotes and Eukaryotes- Morphology and structure
2.2 Chemical composition of bacteria
2.3 General characteristics of major groups of bacteria- Archebacteria, Actinomycetes, Rickettsiaes, Chlamydiae and Mycoplasma
2.4 Salient features of fungi, protozoa and algae
2.5 Structure and life cycle of virus (lytic and lysogenic)

Unit 3: Microbial Nutrition and Growth

3.1 Nutritional requirements-macronutrients, micronutrients and growth factors
3.2 Classification of microorganisms based on nutrition
3.3 Laboratory culture of micro organisms
3.4 Modes of cell division
3.5 Process of sporulation
3.6 Growth curve and mathematical expression of growth
3.7 Synchronous and continuous growth
3.8 Methods of growth measurement
3.9 Effects of environmental factors on bacterial growth

PART-B

Unit 4: Microbial Metabolism
4.1 Aerobic & anaerobic respiration,
4.2 Fermentation,
4.3 Entner–Doudoroff pathway
4.4 Photosynthesis,
4.5 Nitrogen fixation

Unit 5: Bacterial Genetics
1.1 Genetic transformation
1.2 Transduction
1.3 Conjugation
1.4 Chromosome mobilization

Unit 6: Control of Microorganisms
6.1 Physical methods- heat sterilization, radiation sterilization, filter sterilization
6.2 Chemical methods- disinfectants and antiseptics

Text Books/ Reference Books:

1. M. T. Madigan, J. M. Martinko and J.Parker, 2010, Biology of Microorganisms, Prentice Hall Int Inc Publication.
2. Pelczar, 2012, Microbiology: Concepts and Application, Tata Mc Graw Hill Publication, New Delhi
3. S.R. Maloy, J.E.Jr Cronan and Friefelder, 2013, Microbial Genetics, D.Jones and Bartlett Publishers
4. G.A. Weistreich, M.D Lechtman, 2014, Microbiology, McMillan Publishing Co. Publication.

Web links:
http://nptel.ac.in/courses/102103015/

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-302)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-302.1	1	1	-	1	-	1	-	-	1	-	-	2	2	2	1	-
PCC-BT-302.2	1	1	1	1	-	1	-	-	2	1	-	2	3	2	2	-
BBT-DS-302.3	1	1	-	2	-	-	-	-	2	1	2	1	2	1	1	-
BBT-DS-302.4	1	1	2	2	2	2	1	1	1	1	1	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-303: BIOCHEMISTRY

Periods/week	Credits	Max. Marks : 200
L: 3 T: 0	3	Continuous Evaluation : 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination:100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:
The students will be able to:
BBT-DS-303.1   describe the structure and function of basic biomolecules.
BBT-DS-303.2   illustrate the anabolic and catabolic pathways of various biomolecules.
BBT-DS-303.3   appraise the significance of enzymes in metabolism of all the biomolecules.
BBT-DS-303.4   to analyze the regulation of metabolism and the various pathological processes

PART-A

Unit 1: Carbohydrates
  1.1   Structure and properties of monosaccharides
  1.2   Structure and properties of oligosaccharides and polysaccharides
  1.3   Ring structure and maturation
  1.4   Homo and heteropolysaccharides
  1.5   Mucopolysaccharides and sialic acids
  1.6   Glycoproteins and their biological functions.

Unit 2: Lipids
2.1 Classification and structure of lipids
2.2 Essential fatty acids- glycerides
2.3 Hydrolysis of fats
2.4 Structure and properties of phospholipids and glycolipids
2.5 Hormones
2.6 Cholesterol- structure and biological importance

Unit 3: Amino acids and Proteins
  3.1   Structure and properties of amino acids
  3.2   General reactions of amino acids
  3.3   Peptide bond
  3.4   Classification of proteins
  3.5   Hierarchy of organization: primary, secondary, tertiary and quaternary structure of proteins
  3.6   Denaturation and renaturation of proteins

PART-B

Unit 4: Enzymes
  4.1   Nomenclature and classification of enzymes
  4.2   Co-enzymes and co-factors
  4.3   Reaction and derivation of Michaelis-Menten equation
  4.4   Lineweaver-Burke plot
  4.5   Inhibition kinetics and allosteric regulation of enzymes
  4.6   Isozymes

Unit 5: Metabolic Biochemistry- I
5.1 Anabolism and catabolism
5.2 Glycolytic pathway
5.3 Tricarboxylic acid cycle
5.4 Gluconeogenesis
5.5 Mitochondrial electron transport chain and oxidative phosphorylation
5.6 Oxidation and Biosynthesis of odd and even carbon saturated fatty acids
5.7 Oxidation and Biosynthesis of odd and even carbon unsaturated fatty acids

Unit 6: Metabolic Biochemistry- II
6.1 General reactions of amino acids: transamination, deamination and decarboxylation
6.2 Metabolic fate of amino group
6.3 Oxidative degradation of amino acid
6.4 Nitrogen excretion and urea cycle
6.5Biosynthesis and break down of purine nucleotides by de-novo and salvage pathways
6.6 Biosynthesis and break down of pyrimidine nucleotide by de-novo and salvage pathways
6.7 Inborn Errors of amino acid and nucleotide catabolism

Text Books/Reference Books:

1. A.L. Lehninger, D.L. Nelson, M.M. Cox, 2014, Principles of Boichemistry, Worth Publications.
2. L. Stryer, J.M. Berg, J.L. Tymoezko, W.H., 2010, Biochemistry, Freeman and Co. Publications.
3. R.K. Murray, P.A. Hayes, D.K. Granner, P.A. Mayes and V.W. Rodwell, 2013, Harper's Biochemistry, Prentice Hall International Publications.
4. D. Freifilder, 2011, Physical Biochemistry, W. H. Freeman & Company

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-303)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-303.1	1	2	-	-	-	-	-	-	1	2	2	1	2	2	2	-
BBT-DS-303.2	2	3	1	1	1	2	1	-	2	2	2	1	2	2	1	-
BBT-DS-303.3	3	3	2	2	2	2	1	-	2	2	2	2	2	2	2	1
BBT-DS-303.4	3	3	2	3	2	3	2	1	2	2	3	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-304A: BIOANALYTICAL TECHNIQUES

Periods/week	Credits	Max. Marks	: 200
L: 3	T: 0 3	Continuous Evaluation	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination:100	

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-304A.1   identify the performance indicators of an analytical instruments and recognize the reliability of the results obtained from a determination.
BBT-DS-304A.2   apply appropriate bioanalytical technique for identification, separation, isolation and purification of biomolecules.
BBT-DS-304A.3   perform qualitative and quantitative analysis of biomolecules after their separation or isolation.
BBT-DS-304A.4 design and integrate different techniques with upstream and downstream biotechnological processes.

PART-A

Unit 1: Principles of Instrumentation
1.1 Functional elements of an instrument
1.2 Performance indicators of an instrument - Sensitivity, linearity, threshold, resolution, Scale readability
1.3 Accuracy
1.4 Precision
1.5 Instrument Errors - Zero Shift error, Span Error and other errors
1.6 Principles of Calibration

Unit 2: Microscopy & Centrifugation
2.1 Principles of Microscopy
2.2 Technical arrangement and working of a Microscope
2.3 Bright Field & Dark Field Microscopy
2.4 Phase Contrast microscopy
2.5 Fluorescence microscopy
2.6 Electron microscopy- Scanning & Transmission.
2.7 Principles of Sedimentation
2.8 Types of centrifuges and their applications
2.9 Differential centrifugation- Sub-cellular Fractionation, Marker enzymes
2.10 Density Gradient centrifugation

Unit 3: Chromatography
3.1 General principles of Chromatography

3.2 Types of Chromatography based on adsorption, partition, ion-exchange, molecular exclusion and affinity Chromatography
3.3 Selection of chromatographic systems
3.4 Paper Chromatography
3.5 Thin Layer Chromatography
3.6 High Pressure Liquid Chromatography
3.7 Gas Chromatography

PART-B

Unit 4: Electrophoresis
4.1 Principles of Electrophoresis
4.2 Electrophoresis of proteins
4.3 Electrophoresis of nucleic acids
4.4 Immuno-electrophoresis
4.5 Isoelectric Focusing
4.6 Two-dimensional gel electrophoresis
4.7 Capillary electrophoresis.

Unit 5: Spectroscopy
5.1 Basic concepts of Spectroscopy
5.2 U.V./Visible spectroscopy
5.3 X-ray spectroscopy
5.4 Spectrofluorimetry
5.5 Infra Red spectroscopy
5.6 Nuclear Magnetic Resonance

Unit 6: Radioisotope Techniques
6.1 Nature of radioactivity
6.2 Properties of α, β and γ rays
6.3 Detection and measurement of radioactivity
6.4 Geiger Muller Counting
6.5 Scintillation counting
6.6 Auto-radiography
6.7 Radio-immunoassay
6.8 Safety aspects and radio-waste management.

Text Books/Reference Books:

1.   K. Wilson and J. Walker, 1994, Principles and techniques of Practical Biochemistry, Cambridge University Press Publication.
2.   G. R. Chatwal & Anand, 2014, Instrumental Methods of Chemical Analysis, Himalaya Publications.
3.   Frederick Dechow, 2010, Separation and Purification Techniques in Biotechnology: Standard Publishers Publication.
4.   D. Freifilder, 2011, Physical Biochemistry, W. H. Freeman & Company

Web links:
http://nptel.ac.in/courses/102107028/
http://nptel.ac.in/courses/102103044/

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-304)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-304.1	1	2	-	2	1	-	-	-	1	2	2	1	2	2	2	-
BBT-DS-304.2	3	3	2	2	2	2	-	-	2	2	2	2	2	2	2	1
BBT-DS-304.3	1	3	1	2	1	2	-	-	1	2	2	1	1	2	2	1
BBT-DS-304.4	3	3	3	3	2	3	2	1	2	2	3	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-305: BIOINFORMATICS
& COMPUTER APPLICATIONS

Periods/week Credits	Max. Marks : 200
L: 3 T:0 3	Continuous Evaluation : 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination:100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-305.1   define basic concepts of computational biology and describe the functionality of various algorithm.
BBT-DS-305.2   connect the protein structure determination tools to prediction methods.
BBT-DS-305.3   appraise the use of sequence alignment and machine learning techniques in biological systems.
BBT-DS-305.4   generalize the concepts of systems biology and synthetic biology.

PART-A
Unit 1: Concepts in Computing
1.1 Introduction to Bioinformatics and Computational Biology,
1.2 Biological sequences
1.3 Genome specific databases
1.4Data file formats
1.5 Database management system models

Unit 2: Algorithm
2.1 Dynamic programming,
2.2 Needleman-Wunch Algorithm,
2.3 Smith-Waterman algorithm.
2.4 Blast and fasta algorithm
2.5Sequence Analysismethods

 Unit 3: Pairwise and Multiple Sequence Alignment
3.1 BLAST, PSIBLAST and PHIBLAST.
3.2 Generating motifs and profiles
3.3 Multiple Sequence alignment (MSA)
3.4 Introduction to phylogenetics
3.5 Distance based trees UPGMA trees

PART-B
UNIT 4: Protein Structure determination and prediction methods
4.1 Protein classification
4.2 Protein structure
4.3 Determination method
4.4 Fold recognition & Prediction
4.5 Homology modeling

4.6 Challenges faced in integration of Biological data

UNIT 5: Machine learning techniques
5.1 Artificial Neural Networks in protein secondary structure prediction
5.2 Support Vector Machines
5.3 Hidden Markov Models for gene finding
5.4 Decision trees

UNIT 6: Systems Biology
6.1 Introduction to Systems Biology and Synthetic Biology
6.2 Applications of informatics techniques in genomics and proteomics
6.3 Assembling the genome
6.4 STS content mapping for clone contigs
6.5 Functional annotation
6.6 Peptide Mass fingerprinting

Text Books / Reference Books:
1. D. W. Mount, 2014, Bioinformatics: Sequence and Genome Analysis, Cold spring Harbour Laboratory Press Publication.
2. C.W. Sensen, 2008, Essential of Genomics and Bioinformatics: John Wiley and Sons Publication.
3. S. C. Rastogi, N. Mendiratta, P. Rastogi , 2004, Bioinformatics : Methods and Applications Genomics, Proteomics and Drug discovery, Prentice Hall of India Pvt. Ltd Publication.
4. A.D. Baxevanis and B.F.F.Ouellette, 2012, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins: A.D. Baxevanis and B.F.F.Ouellette, Wiley interscience Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Web links:
www.ncbi.nlm.nih.gov
www.expasy.org
www.ebi.ac.uk

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS305)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-305.1	1	3	2	2	2	-	-	-	1	1	-	2	2	2	2	-
BBT-DS-305.2	3	3	3	3	3	1	2	-	2	2	3	3	2	2	2	-
BBT-DS-305.3	3	2	-	2	2	-	-	-	2	2	2	2	2	3	2	1
BBT-DS-305.4	3	3	2	2	2	2	2	1	2	2	2	2	2	2	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-351: CELL BIOLOGY LAB

Periods/week	Credits		Max. Marks	:100
P: 2	1		Continuous Evaluation	: 50
Duration of Ext. Exam: 3 Hrs			End Semester Examination: 50	

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course outcomes:

The students will be able to-
BBT-DS-351.1   demonstrate practical skills in observing morphology and histology of cells and tissues in biological samples.
BBT-DS-351.2   apply vatious techniques to determine the cell size, number, viability and other features.
BBT-DS-351.3   distinguish various cellular organelles and compare different stages of cell cycle.
BBT-DS-351.4   combine the methods of isolation, fixation and staining of cells for cytological analyses

List of Experiments:
1.   To study the compound microscope and observe common interfering objects.
2.   To study and observe the structure of prokaryotic cell.
3.   To study and observe the structure of eukaryotic cell.
4.   To isolate lactobacillus from curd sample.
5.   To study the histology of different tissues.
6.   To study the process of cell staining.
7.   To calibrate ocular micrometer and measure the size of cell.
8.   To count the number of cells using haemocytometer.
9.   To study the cell membrane properties.
10. To study the morphology of nuclei in human leucocytes.
11. To determine cell viability using Trypan Blue.
12. To study cellular division in onion root tip   & calculate mitotic index (MI).
13. To perform isolation and sub fractionation of cell organelle.
14. To study the process of fixation and cryofixation.
15. To study the technique of microtomy.

Text Books/Reference Books:
1.   J. Sambrook and D.W. Russell, 2013, Molecular Cloning- a laboratory manual, Cold Spring Harbor Laboratory Press Publication, New York
2.   J. R. Baker, 2010, Cytological Technique, Methuen & Co. Publication.
3.   P. D. Dabre, 1998, Introduction to practical molecular biology, John Wiley & Sons Ltd. Publication, NY.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-351)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O 3	PSO 4
BBT-DS-351.1	2	3	1	1	1	2	-	1	2	2	1	2	3	2	2	-
BBT-DS-351.2	2	3	1	-	1	2	-	1	2	1	-	2	1	2	1	-
BBT-DS-351.3	1	2	1	1	2	-	-	1	2	2	1	2	2	2	2	1
BBT-DS-351.4	1	2	1	-	1	2	1	1	2	2	1	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-352: MICROBIOLOGY LAB

Periods/week   Credits   Max. Marks   :100
P: 3   1.5   Continuous Evaluation   : 50
Duration of Ext. Exam: 3 Hrs   End Semester Examination:50

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course outcomes:
The students will be able to-
BBT-DS-352.1 identify various microorganisms and classify them on the basis of their characteristic features.
BBT-DS-352.2 enumerate and estimate microorganisms isolated from different sources.
BBT-DS-352.3 demonstrate skills for culture and growth of microorganisms in laboratory.
BBT-DS-352.4 compare the characteristics of microorganisms on the basis of qualitative and quantitative tests.

List of Experiments:
1. To study commonly used techniques and equipments in a microbiology laboratory.
2. To prepare culture media for culture of bacteria.
3. To prepare culture media for culture of fungi.
4. To learn pure culture techniques.
5. Isolation and enumeration of microorganisms from different sources.
6. To study the effect of different parameters on the growth of microorganisms
7. To observe the motility of bacteria using hanging drop technique
8. To learn bacterial staining methods.
9. To study the micro flora of skin.
10. To perform IMViC series of test for the identification of enteric bacteria
11. To determine the ability of microorganisms to degrade hydrogen peroxide
12. To compare the effectiveness of disinfectant
13. To perform the quantitative analysis of milk by standard plate count
14. To isolate yeast from fruit sample.
15. To check the quality of milk sample by methylene blue reduction test.

Text/Reference Books:

1. Cappuccino, Sheeman and Addison, 2009, Microbiology lab. Manual: Wesley Publication, California.
2. Alfred Brown, Heidi Smith, 2014, Microbiological Applications (Laboratory manual in general microbiology), Mc Graw Hill, New York.
3. S.K.Sawhney & Randhir Singh, 2011, Introductory Practical Biochemistry, Narosa Publising House, New Delhi.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-352)	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-352.1	2	2	1	2	1	3	3	2	2	2	1	2	2	2	2	1
BBT-DS-352.2	3	3	1	1	1	3	3	2	2	2	1	2	-	-	-	-
BBT-DS-352.3	3	3	1	1	1	3	3	2	2	2	1	2	-	-	-	-
BBT-DS-352.4	2	2	1	2	1	3	3	2	2	2	1	2	2	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-353: BIOCHEMISTRY &BIOANALYTICAL TECHNIQUES LAB

Periods/week   Credits
P: 3   1.5
Duration of Ext. Exam: 3 Hrs

Max. Marks   :100
Continuous Evaluation   : 50
End Semester Examination:50

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course outcomes:

The students will be able to-
BBT-DS-353.1   identify the usage of various bioanalytical instruments and select them appropriately for an experiment.
BBT-DS-353.2   estimate the type and amount of biomolecules through biochemical tests and assays.
BBT-DS-353.3   select suitable analytical system for efficient separation and characterization of different biomolecules.
BBT-DS-353.4   combine various techniques for complete qualitative and quantitative analyses of biomolecules

List of Experiments:

1. To perform measurements of volume, weight, concentrations, pH and prepare buffers.
2. To perform qualitative and quantitative estimation of proteins.
3. To perform qualitative and quantitative estimation of lipids.
4. To perform qualitative and quantitative estimation of carbohydrates,
5. To study the effect of temperature and pH on salivary amylase activity.
6. To determine K_m and V_{max} for salivary amylase.
7. To biochemically analyse the normal and abnormal constituents of urine.
8. To quantitatively determinethe amount of DNA and RNA by spectrophotometric method
9. To study phase contrast microscopy technique.
10. To fractionate leaf cell using differential centrifugation technique.
11. To separate biomolecules using paper/ thin layer chromatography.
12. To partially purify protein by ion exchange chromatography.
13. To determine molecular weight of a biomolecule by gel filtration.
14. To separate proteins by SDS-PAGE.
15. To prepare an absorption spectrum and determine the molar extinction coefficient of NADH using spectrophotometer.

Reference Books:

1. S.K.Sawhney & Randhir Singh, 2011, Introductory Practical Biochemistry, Narosa Publising House, New Delhi.
2. L. Stryer, J.M. Berg, J.L. Tymoezko, W.H., 2010, Biochemistry, Freeman and Co. Publications.
3. R.K. Murray, P.A. Hayes, D.K. Granner, P.A. Mayes and V.W. Rodwell, 2013, Harper's Biochemistry, Prentice Hall International Publications.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-353)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-353.1	2	2	1	2	1	3	3	2	2	2	1	2	2	2	2	1
BBT-DS-353.2	3	3	1	1	1	3	3	2	2	2	1	2	-	-	-	-
BBT-DS-353.3	3	3	1	1	1	3	3	2	2	2	1	2	-	-	-	-
BBT-DS-353.4	2	2	1	2	1	3	3	2	2	2	1	2	2	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-354A: BIOINFORMATICS & COMPUTER APPLICATIONS LAB

Periods/week   Credits   Max. Marks   : 100
P: 2   1   Continuous Evaluation: 50
Duration of Ext. Exam: 3 Hrs   End Semester Examination: 50

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course outcomes:
     The students will be able to:
     BBT-DS-354A.1 develop a working knowledge of using various tools of bioinformatics and use of databases
     BBT-DS-354A.2 demonstrate the local and global alignment search tools for DNA sequence analysis
     BBT-DS-354A.3 determine molecular weight and secondary structure of proteins.
     BBT-DS-354A.4 predict gene behavior using appropriate tools.

List of Experiments:

1. To study literature searches method using Pubmed.
2. To perform DNA sequence analysis using BLAST.
3. To perform multiple sequence analysis using Clustal-Omega.
4. To Understand KEGG database for biological pathways.
5. To find domain and pattern in protein sequences.
6. To analyze molecular weight of proteins using PROTPRAM.
7. To analyze 3D structure of protein using RASMOL through command line.
8. To analyze 3D structure of protein using PyMOL.
9. To search for gene expression data using GEO.
10. To screen for vector contamination using VEC SCREEN.
11. To study different database models.
12. To study inherited diseases in humans using OMIM.
13. To study gene prediction using GENSCAN.
14. To compute and verify restriction maps in a given DNA sequencing data.
15. To perform phylogenetic analysis using webtool.

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Text Books / Reference Books:

1. S. C. Rastogi, N. Mendiratta, P. Rastogi , 2004, Bioinformatics : Methods and Applications Genomics, Proteomics and Drug discovery, Prentice Hall of India Pvt. Ltd Publication.
2. A.D. Baxevanis and B.F.F.Ouellette, 2012, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins: A.D. Baxevanis and B.F.F.Ouellette, Wiley interscience Publication.
3. Alfred Brown, Heidi Smith, 2014, Microbiological Applications (Laboratory manual in general microbiology), Mc Graw Hill, New York.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-354)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O 2	PS O 3	PS O 4
BBT-DS-354.1	3	3	3	2	1	3	3	1	1	1	1	1	3	2	2	2
BBT-DS-354.2	3	3	1	-	1	3	3	-	1	1	-	2	1	-	2	2
BBT-DS-354.3	3	3	1	2	2	3	3	2	1	1	2	-	1	1	2	2
BBT-DS-354.4	3	3	-	-	1	3	3	1	1	1	3	1	1	1	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

NAAC 'A' Grade University

DTI-300: DESIGN, THINKING AND INNOVATION – I

Periods/week   Credits

P: 1   1.0

Max. Marks   : 50

Continuous Assessment : 50

Pre-requisites: Nil
Course Type: Research & Training
Course Coordinator: Research Mentor

Course Outcomes:

RIC 300.1. To explore different sources for generating ideas for Research.

RIC 300.2. To understand the problem classification based on domain specific resources.

RIC 300.3.To realize the design thinking stages.

RIC 300.4.Topresent critical analysis of literature survey.

Activity 1: Motivation
    1.1 Divergent thinking and brain storming
    1.2 Creative process

Activity 2: Introduction to Design Thinking
    2.1 Empathize Mode
        2.1.1 Discussions and deliberations
    2.2 Define Mode
    2.3 Ideate Mode
        2.3.1Contemporary Relevance.
        2.3.2 Tools and techniques for generating ideas
        2.3.3 Idea Challenges

Activity 3: Problem Classification
    3.1 Domain Classification.
    3.2 Identification of Mentors

Activity 4: Problem identification
    4.1 Literature survey and option analysis.
    4.2 Feasibility study.
    4.3 Formulation of problem statement.
    4.4Expected Outcome / Model of the problem.
    4.5 Planning Matrix

Activity5: Presenting the Ideation
    5.1 Structuring and preparation of PPT
    5.2 Review on presentation skills and content delivered
    5.3 Incorporating the review comments.

Course Articulation Matrix:

CO Statement (RIC-300)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
DTI-300.1	2	2	2	3	1	1	2	1	1	3	2	1	2	3	2	3
DTI-300.2	2	3	2	3	3	2	1	1	2	3	2	2	3	2	2	2
DTI-300.3	2	2	2	2	1	1	1	1	2	2	2	1	3	2	2	2
DTI-300.4	1	1		1	2	1	1	2	2	2	2	1	2	2	3	2

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No:	Parameters	Description	Marks	
1.	**Attendance**	Percentage of classes attended by the students	5	5
2.	**Continuous Performance**	Group participation and response of the students to a given task:		15
		Judge individual student in the group	5	
		Meeting timelines as per activity plan	10	
3.	**Literature Review**	Student interaction with faculty mentors	5	15
		Relevance of the topic	3	
		Usage of Scientific Literature Databases. e.g., Scopus/ Web of Science/ etc.	2	
		Number of relevant papers / design referred for the given topic	5	
4.	**PPT & Report**	Report structure and Slide sequence	5	15
		Contribution of individual group member towards the presentation and report	5	
		Scientific/Technical writing	5	
		Max. Marks	**50**	**50**

References:

1. http://nptel.ac.in/courses/121106007/
2. http://public.wsu.edu/~taflinge/research.html

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

BHM-MC-004: QUANTITATIVE APTITUDE

Periods/week	Credits	Max. Marks	: 100
P:2	AP	Continuous Evaluation	: 50
Duration of Exam: 2 hrs		End Semester Examination(Written)	: 50

Pre-requisites: None
Course Type: HSMC

Course Outcomes:
Students will be able to
BHM-MC-004.1. recognize problems based on arithmetic & number system.
BHM-MC-004.2. solve problems based on verbal reasoning & simplification.
BHM-MC-004.3. calculate the correct answers to the problems within given time.
BHM-MC-004.4. plan their career meticulously by setting their time oriented goals.
BHM-MC-004.5. introspect and enhance their personality.
BHM-MC-004.6.develop cultural sensitivity and communicate respectfully across cultures.

PART – A
Unit 1: Number System 1
1.1 Vedic Mathematics
    1.1.1 Basic of mathematics
    1.1.2 Addition and subtraction using Vedic Mathematics
    1.1.3 Multiplication of two and three numbers.
1.2 Simplification
    1.2.1 BODMAS rule
    1.2.2 Fractions and recurring decimals
    1.2.3 Surds and indices
1.3 Numbers
    1.3.1 Types of numbers and number tree
    1.3.2 Divisibility Rule
    1.3.3 HCF & LCM

Unit 2: Verbal Reasoning 1
2.1 Direction Sense Test
2.2 Blood Relation Test

Unit 3: Arithmetic 1
3.1 Problem on Ages
3.2 Problem on Numbers
3.3 Averages

Part B

Unit 4: Career Planning
4.1 **Career planning Process** - Self Evaluation, Research, Decision Making, Action and Employability
4.2 **Goal Setting:** Relevance, SMART goals, The Dos & Don'ts

Unit 5: Personality Enhancement
5.1   **Emotional Intelligence:** Emotional Self -Awareness, Self- Control, Emotional Management
5.2   **Stress Management:** What is Stress, Types of Stress, Stress Response Example, Vulnerability to Stress, Why do we Stress out, Stress Warning Symbols, Suggestions for Reducing Stress,
5.3   **Time Management:** Setting Priorities, Managing Time, Four Quadrants of Time Management
5.4.   **Team Building:** Definition –Team, Characteristics of effective Teams, Competence, Clear and Compelling goal, Supportive Environment, Alignment, Designing the Team, Identifying Roles and Responsibilities, Determining Reward, Troubleshooting Guide, Good Team member

Unit 6: Effective Communication
6.1   **Courtesy in Communication:** Being Polite, Self -Discipline, Respecting Others and understanding other's perspective in communication
6.2   **Inter cultural Communication:** Breaking Stereotypes, Diversity Inclusion and Cultural Sensivity

Text Books/Reference Books:
1.   R S Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations: S Chand & Company Pvt Ltd.
2.   R S Aggarwal, 2018, A Modern Approach to Verbal& Non Verbal Reasoning, S Chand & Company Pvt. Ltd.

Instructions for paper setting: Fifty MCQ will be set in total. TwentyFiveMCQwillbe set from Part A and Twenty Five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Distribution of Continuous Evaluation:

Sessional- I	15%
Sessional- II	15%
Assignment/Tutorial	10%
Class Work/ Performance	5%
Attendance	5%

Course Articulation Matrix

CO (BHM-MC-004)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BHM-MC-004.1	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-
BHM-MC-004.2	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-
BHM-MC-004.3	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
BHM-MC-004.4	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-
BHM-MC-004.5	-	-	-	-	-	-	-	1	3	3	-	1	-	-	-
BHM-MC-004.6	-	-	-	-	-	-	-	1	2	3	-	1	-	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

PROJ-BT-300:SUMMER INTERNSHIP I

Credits : 2

Max. Marks   : 50
Continuous Evaluation : 50

PROJ-BT-300.1 learn to communicate effectively in corporate/ industry set-up.
PROJ-BT-300.2 improve the requisite skills in biotechnology
PROJ-BT-300.3 pursue research on relevant problems
PROJ-BT-300.4 demonstrate the ethical practices in industry.

Pre-requisites: None

Each student is required to accomplish at least 4 Weeks of Internship/ Training at the end of Second Semester and before the commencement of Third semester, i.e. in the month of June- July. The training shall be conducted within the institution and shall aim to hone the skills of students. The evaluation of this Internship/ training is to be done as continuous Evaluation based on their regularity and overall performance during the Internship. The marks of this evaluation shall be included in the result of Third Semester.

Course Articulation Matrix

SUMMER INTERNSHIP	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PS O 2	PS O 3	PS O 4
PROJ-BT-300.1	3	3	1	2	3	3	2	2	2	2	3	3	3	3	3	2
PROJ-BT-300.2	3	3	1	3	3	1	1	1	2	1	3	3	3	3	3	1
PROJ-BT-300.3	2	2	1	3	3	1	1	1	1	1	2	2	3	3	3	1
PROJ-BT-300.4	2	2	3	1	1	3	3	3	2	3	2	2	1	1	1	3

4thSEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-401: MOLECULAR BIOLOGY

Periods/week   Credits
L: 3   T: 0   3
Duration of Ext. Exam: 3 Hrs

Max. Marks   : 200
Continuous Evaluation : 100
End Semester Examination: 100

Pre-requisites: Cell Biology (BBT-DS-301)
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-401.1 recognize the basic structure and organization of genetic material in prokaryotes and eukaryotes.
BBT-DS-401.2 analyze the structure, organization, function and regulation of genetic elements.
BBT-DS-401.3 compare the complex processes involved in function and regulation of DNA and RNA.
BBT-DS-401.4 integrate the molecular processes to understand vital life functioning.

PART-A

Unit 1: DNA
1.1 DNA bending, DNA super coiling
1.2 Cruciform and ZDNA structure, DNA Triplex
1.3 DNA protein interactions
1.4 Packaging in nucleosomes
1.5 Chromosome organization in cell
1.6 Denaturation and renaturation of DNA - Tm values
1.7 Cot curves analysis,C-value paradox
1.8 Repetitive and non repetitive inverted and tandem repeats

Unit 2: DNA Replication
2.1 Modes of DNA Replication
2.2 Origin of replication
2.3 DNA polymerase
2.4 Mechanism of DNA replication in prokaryotes and eukaryotes
2.5 DNA damage and repair.

Unit 3: Transcription
3.1 Mechanism in prokaryotes and eukaryotes
3.2 RNA polymerase, sigma factor
3.3 Post transcriptional processing -5' end capping and 3' polyadenylation
3.4 RNA splicing: intron and exon splicing, spliceosome, lariat formation

PART-B

Unit 4: Operon Model
4.1 Regulation of gene expression in prokaryotes
4.2 Inducible systems- Lactose operon
4.3 Repressible systems-Tryptophan operon
4.4 Regulation of gene expression in eukaryotes zinc finger motifs, helix loop helix, leucine zippers.

Unit 5: Protein Synthesis

5.1 Component of Protein synthesis-ribosomes, tRNA, mRNA, rRNA
5.2 Mechanism of Protein synthesis
5.3 Post transtational modification
5.4 Transport of protein
5.5 Degradation of protein

Unit 6: Transposons
6.1 Mobile genetic elements in prokaryotes-insertion sequences
6.2 Composite and non composite transposons
6.3 Replicative and conservative transposition
6.4 Retrotransposon
6.5 Eukaryotic Jumping genes – relevance to plants

Text Books/Reference Books:

1. Richard R Sinden, 2006, DNA structure and function, 12th Edition, Academic Press Publication.
2. B. Lewin, 2011, Genes XII, 12th Edition, Oxford University Press Publication.
3. Bruce Alberts, J.D. Watson, 2009, Molecular Cell Biology: Garland Publication.
4. Cooper, 2008, The cell – a molecular approach, A.S.M. Press Publication.

Web links:
http://nptel.ac.in/courses/102106025/

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-401)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PSO 2	PS O 3	PS O 4
BBT-DS-401.1	3	3	1	1	2	1	-	-	2	1	-	2	3	3	2	1
BBT-DS-401.2	3	3	3	3	3	2	2	-	2	1	3	3	2	2	1	1
BBT-DS-401.3	3	1	-	2	2	-	-	-	2	1	2	1	-	1	1	-
BBT-DS-401.4	3	3	2	2	2	2	2	-	2	1	3	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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BBT-DS-402: IMMUNOLOGY

Periods/week	Credits		Max. Marks	: 200
L: 3	T: 0	3	Continuous Evaluation	: 100
Duration of Ext. Exam: 3 Hrs			End Semester Examination: 100	

Prerequisites: Cell Biology (BBT-DS-301)
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-402A.1 describe various immune cells and organs describing their function in defense mechanism.
BBT-DS-402A.2 classify and explain the structure and function of antibodies and their immunity reactions.
BBT-DS-402A.3 interpret the role of genetics in generating antibodies, HLA and MHCs.
BBT-DS-402A.4 distinguish, analyze and demonstrate different immunotechniques and vaccine designing

Unit 1: Introduction
1.1 Historical background of immunology
1.2 General concepts of the immune system, innate and adaptive immunity
1.3 Cells of immune system- T and B-lymphocytes, NK cells, monocytes and macrophages, neutrophils, eosinophils, and basophils, mast cells and dendritic cells
1.4 Thymus and bone marrow
1.5 Lymph nodes and spleen
1.6 MALT, GALT and CALT

Unit 2: Chemical aspects of immunology
2.1 Nature of antigens
2.2 Antibody structure,
2.3 Classification and functions of antibodies - IgG, IgA, IgM, IgD, IgE
2.4 Serological analysis of antibodies- isotypes, allotypes, idiotypes
2.5 Complement system and cytokines

Unit 3: Immunogenetics
3.1 Immunoglobulin gene,
3.2 Heavy and light genes
3.3 Gene rearrangements and generation of antibody diversity.
3.4 Major Histocompatibility Complex (MHC)
3.5 Human leucocytes antigen (HLA) restriction.

<div align="center">**PART-B**</div>

Unit 4: Polyclonal and monoclonal antibodies
1.1   Adjuvants and its types
1.2   Polyclonal and Monoclonal Antibodies
1.3   Preparation of hybridomas
1.4   Selection and characterization of monoclonal antibodies
1.5   Imunotherapy of infectious diseases – bacterial, protozoal and viral infections

Unit 5: Immunotechniques
5.1 ELISA
5.2 RIA
5.3 Immune blot
5.4 Immunoflourescence
5.5 Agglutination
5.6 Precipitation in liquids and semisolids
5.7 Immunodiffusion
5.8 Immunoelectromicroscopy
5.9 Flow cytometry

Unit 6: Applied Immunology
6.1 Hypersensitivity reactions – immediate and delayed type hypersensitivity
6.2 Autoimmune disorders
6.3 Transplantation immunity
6.4 Tumor immunology
6.5 Immune-deficiency diseases
6.6 Vaccines and their types

Text Books/Reference Books:
1.   R. A. Goldsby, T.J. Kindt, B.A. Osborne, 2011, Kuby- Immunology, W H Freeman & Co Publication.
2.   W.E. Paul, 2006, Fundamentals of Immunology, Raven Press Publication, New York.
3.   Pelczar, 2012, Microbiology: Concepts and Application, Tata Mc Graw Hill Publication, New Delhi

Web links:
http://www.roitt.com/

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%

Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-402)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-402.1	3	2	1	1	2	2	1	-	2	1	2	2	3	2	2	1
BBT-DS-402.2	3	2	1	1	2	1	1	1	1	2	1	2	3	2	2	1
BBT-DS-402.3	3	2	1	1	2	1	1	1	1	2	1	2	3	2	2	1
BBT-DS-402.4	3	3	1	2	2	1	1	2	2	1	2	2	3	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-403A: FERMENTATION TECHNOLOGY

Periods/week   Credits   Max. Marks   : 200
L: 3   T: 0   3   Continuous Evaluation   : 100
Duration of Ext. Exam: 3 Hrs   End Semester Examination: 100

Prerequisites: Microbiology (BBT-DS-302)
Course Type: Core

Course Outcomes:

The students will be able to:
BBT-DS-403A.1select and evaluate bioreactors and bioprocess operations for particular applications.
BBT-DS-403A.2 quantitatively assess the kinetics and economics of bioprocess operations.
BBT-DS-403A.3compare the microbial growth kinetics of different types of microbial cultures.
BBT-DS-403A.4analyze and integrate different aspects of upstream and downstream processing.

PART-A

Unit 1: Introduction to Fermentation Technology
1.1 Features of biotechnological processes
1.2 Upstream and downstream processing
1.3 Role of biochemical engineers in biotechnology
1.4 Nutritional requirements of microorganisms
1.5 Media formulation for industrial fermentations
1.6 Medium optimization

Unit 2: Strain Development
2.1 Isolation methods of industrially important microorganisms.
2.2 Screening methods of industrially important microorganisms
2.3 Improvement of industrial microorganisms using classical methods
2.4 Improvement of industrial microorganisms using recombinant DNA approaches.
2.5 Preservation methods

Unit3: Microbial Growth Kinetics
3.1 Cell growth kinetics in batch culture
3.2 Continuous culture
3.3 Fed-batch culture
3.4 Comparison of batch and continuous culture in industrial processes
3.5 Kinetics of product formation.

PART-B
Unit 4: Bioreactors and their operation
4.1 Stirred tank bioreactors
4.2 Bioreactors for immobilized cells and enzymes
4.3 Bioreactors for animal and plant cell cultures

4.4 Bioreactors for treatment of waste water

Unit5: Sterilization
5.1 Methods Of Sterilization
5.2 Thermal Death Kinetics
5.3 Medium Sterilization
5.4 Design Of Batch And Continuous Sterilization Processes
5.5 Filter Sterilization.

Unit 6: Downstream Processing and Economics
6.1 Classification Of Bioproducts
6.2 Basis Of Bioseparation
6.3 Industrial Cell Separation Techniques
6.4 Cell Disruption
6.5 Chromatographic Techniques In Downstream Processing
6.6 Case Study- Penicillin, Ethanol, Insulin
6.7 Introduction to fermentation economics

Text Books/ Reference Books:
1. Gregory Stephanopoulos, Aristos Aristidou, Jens Nielsen, 2003, Metabolic Engineering: Principles and Methodologies, Academic Press Publications.
2. Gregory Stephanopoulos, 2005, Metabolic Engineering, Elsevier India Publication.
3. P.F. Stanbury, and A. Whitaker, 1984, Principles of Fermentation Technology, Pergamon Press.

Web links:
https://www.boundless.com/microbiology/textbooks/boundless-microbiology-textbook/
http://nptel.ac.in/courses/103105054/
https://www.nap.edu/read/2052

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-403)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-403.1	2	2	2	-	1	2	2	1	1	1	-	2	3	3	2	-
BBT-DS-403.2	1	1	-	2	2	-	-	-	2	1	2	1	2	1	1	1

BBT-DS-403.3	2	1	2	2	2	2	2	-	2	1	-	2	2	2	1	1
BBT-DS-403.4	1	2	2	2	2	1	2	2	1	1	1	2	2	1	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-404: BIOSTATISTICS

Periods/week   Credits   Max. Marks   : 200
L: 2   T: 1   3   Continuous Evaluation   : 100
Duration of Examination: 3 Hrs   End Semester Examination: 100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-404.1   apply statistical methods to analyze biological data and make predictions of the outcomes.
BBT-DS-404.2   analyze randomness and uncertainty through probability models, random variables and their distributions, and conditional thinking.
BBT-DS-404.3   apply statistical tools in deciphering science, engineering concepts, and everyday life.
BBT-DS-404.4   Design independently the experimental set ups using statistical tools

PART A

Unit 1: Introduction to statistics
1.1 Introduction to data: definition, types of variables
1.2 Data collection principles
1.3 Line graph, scatter diagrams, bar graph, Histogram, Frequency polygon, frequency curve, relative frequency curve, pie chart, box plots, stem and leaf plots

Unit 2: Descriptive statistics
2.1 Measures of frequency: Count, percent, frequency
2.2 Measures of central tendency: Mean, mode, median, Harmonic mean, Geometrical mean, Measures of dispersion: Range, mean deviation, variance, standard deviation, coefficient of variance
2.3 Measure of position: percentiles, quartiles, standard scores.
2.4 Skewness and Kurtosis

Unit 3: Probability Distributions
3.1 Introduction to probability, probability rules, conditional probability
3.2 Random variables - Discrete and continuous.
3.3 Properties and application of Binomial, Poisson and Normal distributions.

PART B

Unit 4 : Sampling
4.1 Introduction to sampling, Types of sampling.
4.2 Errors, standard error, confidence limits.
4.3 Tests of Hypothesis: Introduction
4.4 Hypothesis-Null and Alternative Hypothesis
4.5 Student's t-distribution
4.6 Type I and Type II errors
4.7 Level of significance - One tail and two-tail tests- Tests concerning one mean and proportion, two means- Proportions and their differences.

4.8 ANOVA for one-way and two-way classified data.

Unit 5: Nonparametric Tests
5.1 Nonparametric methods.
5.2 Wilcoxon pair test, sign test.
5.3 Chi-square test of goodness of fit
5.4 Advantages and disadvantages of Nonparametric and parametric method.

Unit 6: Correlation and Regression
6.1 Introduction to correlation, Rank's Correlation methods.
6.2 Introduction to regression lines.
6.3 Linear and nonlinear fitting (least square method).
6.4 Multiple regression.
6.5 Advantages and disadvantages of Correlation and regression.

Text / Reference Books:
1. S. C. Gupta and V. K. Kapoor, 2011, Mathematical Statistics, Sultan Shand & Sons Publication.
2. J. H. Zar, 2013, Bio-statistical Analysis, Pearson Publication.
3. Khan & Khanum, 2013, Bio-statistical Methods, Unkar Publication, Hyderabad.
4. Bernard Rosner, 1999, Fundamentals of Biostatistics: Thomson Brooks/Cole Publication.

Weblinks:
http://nptel.ac.in/courses/111101004/
http://nptel.ac.in/courses/111105090/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-404)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-404.1	2	2	2	2	2	1	1	2	1	2	1	2	3	3	2	1
BBT-DS-404.2	3	3	2	1	1	2	1	1	2	2	2	1	3	3	2	1
BBT-DS-404.3	3	3	2	2	2	2	1	1	2	2	2	1	3	3	2	1
BBT-DS-404.4	3	3	3	3	2	3	2	1	2	2	3	2	3	3	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-405: BIOSAFETY AND BIOETHICS & IPR

Periods/week   Credits
L: 2   T: 02
Duration of Ext. Exam: 3 Hrs

Max. Marks   : 200
Continuous Evaluation   : 100
End Semester Examination: 100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-405.1   Distinguish social, ethical, legal and economic issues in biotechnology.
BBT-DS-405.2   Assess biosafety issues regarding human health and environment.
BBT-DS-405.3   analyze biosafety evaluation procedures for genetically modified food.
BBT-DS-405.4   evaluate the need of protection of intellectual property and design the strategy for patenting of biotechnological inventions.

PART-A

Unit 1: Introduction to Bioethics
1.1.   Social and ethical issues in Biotechnology
1.2.   The legal and socioeconomic impacts of biotechnology
1.3.   Public education of the processes of biotechnology
1.4.   Public acceptance issues in biotechnology
1.5.   Biotechnology and social responsibility

Unit 2: Biotechnology and Bioethics
2.1.   Ethical conflicts in biotechnology
2.2.   Interference with nature, fear of unknown
2.3.   Unequal distribution of risks and benefits of biotechnology
2.4.   Ethical dimensions of IPR
2.5.   Technology transfer and international relations
2.6.   Globalization in biotechnology.

Unit 3: Biosafety concepts and issues
3.1.   Definition of Biosafety
3.2.   Biosafety for human health and environment
3.3.   Perceptions of risks and benefits
3.4.   The GM-food debate
3.5.   Biosafety Evaluation procedures for biotech foods
3.6.   Pharmaceutical products such as drugs/vaccines.

PART-B
Unit 4: Biosafety regulations
4.1.   Catagena protocol on biosafety

4.2. Laboratory associated infections and other hazards
4.3. Evaluation of biological hazards and levels of biosafety
4.4. Prudent biosafety practices in the laboratory/ institution
4.5. Handling of recombinant DNA processes
4.6. Handing for BT products in institutions and industries
4.7. Biosafety Evaluation procedures in India and abroad
4.8. Bioterrorism
4.9. Biological weapons

Unit 5: Intellectual Property Rights-I
5.1.   Patents – definition, basic requirements
5.2.   Conditions for patentability
5.3.   Test of novelty of patents
5.4.   Composition of a patent
5.5.   Patent claims, the legal decision – making process
5.6.   The forms of IPR – Copyright, Trademark, Designs
5.7.   Legal implications of patent
5.8.   Disclosure requirements
5.9.   Collaborative research
5.10. Competitive research

Unit 6 :Intellectual Property Rights-II
6.1.   Indian patents and Foreign patents in plant biotechnology
6.2.   Plant variety protection act
6.3.   The strategy of protecting plants
6.4.   Plant breeder's rights
6.5.   IPR issues in Indian Context
6.6.   Role of patent in pharmaceutical industry and agriculture
6.7.   Recent Developments in Patent System
6.8.   Patentability of biotechnological inventions.

Text / Reference Books:
1. J.A. Thomas, R.L. Fuch, 2010, Biotechnology and Safety Evaluation, Academic Press Publication.
2. D.A. Fleming, D.L. Hunt, 1995, Biological safety Principles and practices, ASM Press Publication, Washington.
3. O'Donnell, R.W., O'Malley, J.J., Huis, R.J., Halt, G.B.J., 2011, Intellectual Property in the Food Technology Industry, Springer

Software required/Weblinks:
http://www.unesco.org/new/en/social-and-human-sciences/themes/bioethics/

Instruction for paper setting: Seven questions are to be set in total.   First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-405)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-405.1	--	1	--	--	--	--	--	1	--	--	--	1	--	2	--	3
BBT-DS-405.2	--	--	--	--	--	--	1	3	--	--	--	--	1	--	--	3
BBT-DS-405.3	--	--	1	--	1	1	--	3	--	1	--	2	--	--	1	3
BBT-DS-405.4	--	--	--	--	--	--	--	3	--	--	--		1	2	--	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-406: Engineering Economics

Periods/week Credits	Max. Marks : 200
L: 2 T: 0 2	Continuous Evaluation : 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination: 100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-406.1   discuss the role of economics in the decision making process.
BBT-DS-406.2   perform calculations in regard to mathematical components of economics.
BBT-DS-406.3   recognize the advanced concepts of engineering economic analysis.
BBT-DS-406.4   evaluate the present, annual and future worth comparisons for cash flows and estimate of future events.

PART-A

Unit 1: Introduction
Definition, nature, scope and significance of Economics for Engineers.
Demand and Supply: Demand – Types – Determinants – Law of Demand – Elasticity of Demand – Types – Significance – Supply – Market price determination – Case Study in Demand Forecasting –- Meaning – Methods – Consumer Survey – Trend Projections, Moving average.

Unit 2: Cost and Revenue
Cost and Revenue Concepts – Classifications – Short run and long run cost curves – Revenue – Concepts – Measurement of Profit (Case Study).

Unit 3: Market Structure
Perfect Competition – Characteristics – Price and output determination in short run and long run – Monopoly – Price Discrimination – Monopolistic Competition – Product Differentiation – Oligopoly and Duopoly.

Market Failure: Causes – Type of Goods – Rivalrous and Non-rivalrous goods – Excludable and Non-excludable goods – Solutions – Government Intervention.

PART-B

Unit 4:Money and Banking
Money – Functions – Quantity theory of money – Banking – Commercial Banks – Functions – Central Bank (RBI) – Functions – Role of Banks in Economic Development.

Unit 5:Foreign Exchange
Balance of Payments – Exchange rate determination – Methods of foreign payments – International Institutions – IMF, IBRD.

Unit 6:Business Cycle and National Income
Meaning –Phases of business cycle – Inflation, – Causes – Control measures - Deflation - National Income – Concepts – Methods of calculating national income – Problems in calculating national income.

Text Books:
1. PremvirKapoor, 2018, "Sociology & Economics for Engineers", Khanna Publishing House.

2. K.K.Dewett, M.H.Navalur, 2014, "Modern Economic Theory", S. Chand and Company Ltd, New Delhi, 24thEdn
3. Lipsey& Chrystal, 2010, "Economics", Oxford University Press.

References:
1. P. A Samuelson & William,2012 "Economics", Tata McGraw Hill, New Delhi.
2. F. Cherinullem 2011, "International Economics", McGraw Hill Education.
3. W. A McEachern and Indira A.,2014, "Macro ECON", Cengage Learning.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering the entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Students need to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-406)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-406.1	--	1	--	--	--	--	--	1	--	--	--	1	--	2	--	3
BBT-DS-406.2	--	--	--	--	--	--	1	3	--	--	--	--	1	--	--	3
BBT-DS-406.3	--	--	1	--	1	1	--	3	--	1	--	2	--	--	1	3
BBT-DS-406.4	--	--	--	--	--	--	--	3	--	--	--		1	2	--	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-451: MOLECULAR BIOLOGY LAB

Periods/week   Credits   Max. Marks   : 100
P: 3   1.5   Continuous Evaluation   : 50
Duration of Ext. Exam: 3 Hrs   End Semester Examination: 50

Pre-requisites: Biochemistry &Bioanalytical Techniques Lab (BBT-DS-353)
Course Type: Core

The students will be able to:
BBT-DS-451.1   describe the techniques involved in molecular biology
BBT-DS-451.2   demonstrate skills in isolation, quantification and purification of DNA.
BBT-DS-451.3   apply the molecular biology techniques for genetic testing
BBT-DS-451.4   design molecular biology techniques for novel applications

List of Experiments:
1. Isolation of prokaryotic DNA
2. Isolation of DNA from Yeast
3. Isolation of DNA from Plant cells.
4. Isolation of plasmid DNA
5. Molecular weight characterization of a given DNA sample using Agarose Gel Electrophoresis
6. To perform the technique of Gel Extraction of DNA.
7. To study and perform the basic scheme of Polymerase Chain Reaction
8. To study and perform the basic scheme of Reverse Transcciption Polymerase Chain Reaction
9. Isolation of protein fraction from different sources.
10. To study the technique of SDS-PAGE
11. To perform native PAGE of protein
12. To perform and compare different staining methods of proteins.
13. To study and perform the technique of Restriction mapping
14. To study and perform the technique of RFLP
15. To study DNA sequencing Data Analysis.

Text/ Reference Books:
1. Molecular Cloning- a laboratory manual: J. Sambrook and D.W. Russell, Cold Spring Harbor Laboratory Press Publication, (2013), 4th Edition.
2. J. R. Baker, 2010, Cytological Technique, Methuen & Co. Publication.
3. P. D. Dabre, 1998, Introduction to practical molecular biology, John Wiley & Sons Ltd. Publication, NY.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-451)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-451.1	3	3	2	2	2	-	-	1	1	-	-	2	3	3	2	-
BBT-DS-451.2	3	3	3	3	3	2	2	1	2	1	3	3	2	2	1	1
BBT-DS-451.3	3	1	-	2	2	-	-	1	2	1	2	1	-	1	1	-
BBT-DS-451.4	3	3	2	2	2	2	2	1	2	1	3	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-452: IMMUNOLOGY LAB

Periods/week Credits		Max. Marks :100
P: 2 1		Continuous Evaluation : 50
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 50

Pre-requisites: Biochemistry &Bioanalytical Techniques Lab (BBT-DS-353)
Course Type: Core

Course outcomes:

The students will be able to-
BBT-DS-452.1   identify various organs and tissues which are the part of immune system of mice.
BBT-DS-452.2   determine the concentration of serum immunoglogulins by different methods.
BBT-DS-452.3   quantitatively measure antigen-antibody reactions.
BBT-DS-452.4   distinguish, analyze and demonstrate different immunotechniques.

List of Experiments:
1. To study anatomy of the experimental model- mice
2. To determine concentration of Total Immunoglobulins by Zinc turbidity test
3. To determine the concentration and partial purification of serum immunoglogulinsbyprecipitation with ammonium sulphate and polyethylene glycol
4. Planning of immunization schedule and preparation of adjuvants
5. Preparation of antigen
6. To perform immuno-diffusion by Ouchterlonymethod(qualitative method)
7. To perform precipitation reaction by quantitative method
8. To perform immuno-diffusion by RI method
9. To perform immuno-electrophoresis with a given antigen-antibody system.
10. To perform delayed type hypersensitivity
11. To perform DOT ELISA
12. To perform indirect ELISA
13. To perform sandwich ELISA
14. To perform Complement -Mediated Lysis
15. To identify different IgG isoforms

Text/ Reference Books:
1. C. Frank, Hay Ollwyn, N. Paul, Nelson L. Hudson, 2007, Practical Immunology, Blackwell Science Publication.
2. J. Sambrook and D.W. Russell, 2013, Molecular Cloning- a laboratory manual, Cold Spring Harbor Laboratory Press Publication, New York

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-452)	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-452.1	3	3	3	2	-	3	3	1	1	1	-	-	1	-	2	-
BBT-DS-452.2	3	3	1	-	-	3	3	1	1	1	-	-	1	2	-	1
BBT-DS-452.3	3	3	1	2	-	3	3	1	1	1	-	-	2	-	1	-
BBT-DS-452.4	3	3	-	-	-	3	3	1	1	1	-	-	1	-	2	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-453: FERMENTATION TECHNOLOGY LAB

Periods/week	Credits	Max. Marks	:100
P: 3	1.5	Continuous Evaluation : 50	
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 50	

Pre-requisites: Microbiology Lab (BBT-DS-352)
Course Type: Core

Course outcomes:

Course outcomes:
The students will be able to:

BBT-DS-453.1   isolate, identify and preserve industrially important microbes from different sources
BBT-DS-453.2   assess the effect of various parameters on the growth kinetics of industrial microorganisms
BBT-DS-453.3   determine antimicrobial spectrum of isolated antibiotic producing microorganism.
BBT-DS-453.4   appraise the principles of production of enzymes through fermentation technology.

List of Experiments:

1. Isolation and identification of industrially important microorganisms
2. To study the design and operation of a bioreactor.
3. To study batch growth kinetics and determine key kinetic parameters.
4. To study solid-state fermentation using a fungal strain.
5. To perform microbial media optimization
6. To study the production of protease by *Bacillus subtilis*.
7. To study alcohol production by *S. cerevisae* using apple juice as substrate.
8. To study the production of amylase by *Aspergillusniger* in submerged fermentation.
9. To study the technique of enzyme immobilization using Calcium alginate gel entrapment method.
10. To study the process of kinetics of batch heat sterilization.
11. To study the process of cell lysis using sonicator.
12. To study the technique of ultrafiltration.
13. To carryout bacterial protein purification - ion exchange chromatography and gel filtration chromatography
14. To learn the technique of lyophilization.
15. Industrial visit -to study the production of an industrially important metabolite along with its downstream processing.

Reference Books:
1. Alfred Brown, Heidi Smith, 2014, Microbiological Applications (Laboratory manual in general microbiology), Mc Graw Hill, New York.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-453)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-453.1	2	2	2	2	1	-	-	-	-	-	-	1	2	2	2	-
BBT-DS-453.2	2	2	2	2	1	-	1	-	1	1	1	-	3	3	3	1
BBT-DS-453.3	2	2	2	2	1	-	1	-	1	1	1	1	3	3	3	1
BBT-DS-453.4	2	2	2	2	1	-	-	-	-	-	-	-	2	2	3	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-454: BIOSTATISTICS LAB

Periods/week   Credits   Max. Marks   :100
P: 2   1   Continuous Evaluation : 50
Duration of Ext. Exam: 3 Hrs   End Semester Examination: 50

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course outcomes:

The students will be able to:
BBT-DS-454.1   identify the type of statistics to apply for a given data type.
BBT-DS-454.2   implement appropriate sampling methods to obtain the data.
BBT-DS-454.3   analyze the biological data sets using appropriate statistical toolsand represent them meaningfully through graphs and tables.
BBT-DS-454.4   interpret biological meaning of the calculated statistical values

1. To use different statistical tools available for biological data analysis and their fundamental operations.
2. To design of Biological data sampling.
3. To determine bias and errors in sampling.
4. To calculate frequency estimates and summary statistics of a data and its interpretation.
5. To represent a data in the form of graphs (bar, pie, box plot, scatter plot).
6. To represent a data in the form of graphs (stem plot, leaf plot, volcano).
7. To estimate the means from two groups of data.
8. To carryout hypothesis testing analysis and interpret results.
9. To learn about the sampling distribution of means and confidence intervals for µ.
10. To calculate bionomial probability and its application in biological data.
11. To perform cluster analysis.
12. To estimate sample size required for a biological data using Power analysis.
13. To estimate odds ratio and its interpretation.
14. To perform regression analysis on given biological data sets using appropriate statistical tool and interpret the results.
15. To perform co-relation on give data set using appropriate statistical tool and interpret the results.

Reference Books:

1. S. C. Gupta and V. K. Kapoor, 2011, Mathematical Statistics, Sultan Shand & Sons Publication.
2. J. H. Zar, 2013, Bio-statistical Analysis, Pearson Publication.
3. Khan & Khanum, 2013, Bio-statistical Methods, Unkar Publication, Hyderabad.
4. Bernard Rosner, 1999, Fundamentals of Biostatistics: Thomson Brooks/Cole Publication.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-454)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-454.1	2	2	2	2	1	-	-	1	-	-	-	1	2	2	2	1
BBT-DS-454.2	2	2	2	2	1	-	1	1	1	1	1	-	3	3	3	1
BBT-DS-454.3	2	2	2	2	1	-	1	1	1	1	1	1	3	3	3	1
BBT-DS-454.4	2	2	2	2	1	-	-	1	-	-	-	-	2	2	3	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956**)**

DTI-400: Design, Thinking and Innovation – II

Periods/week   Credits   Max. Marks   : 50
P: 1   1.0   Continuous Assessment   : 50

Pre-requisites: DTI-300: Design, Thinking and Innovation – I
Course Type: Research & Training
Course Coordinator: Research Mentor

Course Outcomes:

RIC 400.1. To understand the research methodologies/approaches/techniques used in the literature
RIC 400.2. To formulate the experimental procedures / algorithms based on research methodology
RIC 400.3.To develop prototype by experiment / simulation.
RIC 400.4.To analyze the recorded data / output.

Activity 1: Methodology Study & Matrix design.
     1.1.Analysis of different approach/methodology adopted by various researchers
     1.2. Comparative analysis
     1.3. Prospective Design.

Activity 2: Design of experiments
     2.1 Finalization of experimental procedure / algorithm design.
     2.2 Procurement of materials / Hardware and Software.
     2.3. Develop experimental setup / design

Activity 3: Execution of experiments/simulations
     3.1.Conduct experiments/ build prototype.
     3.2.Modification of the experimental set-up / algorithm.

Activity 4:
     4.1 Tabulating and analyzingdata / output.
     4.2 Assessment of the output with earlier published work / product
     4.3 Interpretation and presentation of the results / outcome.

Course Articulation Matrix:

CO Statement (RIC-400)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
DTI-400.1	3	3	2	3	2	3	3	2	3	3	3	2	3	3	3	3
DTI-400.2	3	3	2	3	2	3	3	2	1	2	3	2	3	3	3	3
DTI-400.3	3	3	3	3	2	2	2	2	2	2	3	2	3	3	3	3
DTI-400.4	2	2	2	3	2	3	3	3	2	3	3	3	2	2	3	3

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No.	Parameters	Description	Marks
1.	**Attendance**	Percentage of classes attended by the students	**5**
2.	**Continuous Performance**	Group participation and response of the students to a given task: Judge individual student in the group Meeting timelines as per lesson plan	**15**
3.	**Experimental Setup / Design**	Assessment of experimental set up / design Evaluation of result / outcome. Validation of results. Novelty / Relevance of work.	**20**
4.	**Structuring and presentation**	Structuring and presentation Group presentation with individual contribution	**10**

References:

1. http://www.sciencedirect.com/
2. https://www.ncbi.nlm.nih.gov/pubmed
3. https://www.elsevier.com/books-and-journals
4. https://www.plos.org/
5. https://www.deepdyve.com/
6. http://ieeexplore.ieee.org/Xplore/home.jsp
7. https://www.researchgate.net/
8. https://www.science.gov/
9. https://scholar.google.co.in/
10. http://www.popsci.com/

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University
BHM-MC-002: SPORTS AND YOGA

Periods/week   Credits   Max. Marks   : 100
L: 2   T: 0   0   Continuous Evaluation   : 100

Duration of Examination: 1Hr

Pre-requisite: None
Course Type: Audit pass

Course Outcomes: The course will enable the student to-
BHM-MC-002.1. Understandtheimportanceofsoundhealthandfitnessprinciplesastheyrelate
                tobetterhealth.
BHM-MC-002.2.Participate in variety of physical and yogic activities aimed at stimulating their
                continued inquiry about Yoga, physical education, health and fitness.

Unit 1: IntroductiontoPhysicalEducation, Wellness&Lifestyle(6 Lectures)
Meaning&definitionofPhysicalEducation,
Aims&ObjectivesofPhysicalEducation,changingtrendsinPhysicalEducation,
Meaning&ImportanceofPhysicalFitness&Wellness, ComponentsofPhysical fitness, Healthrelatedfitness and
wellness, PreventingHealthThreatsthroughLifestyleChange, ConceptofPositive Lifestyle.

Unit 2: FundamentalsofAnatomy&PhysiologyinPhysicalEducation,Sports&Yoga(8 Lectures)
DefineAnatomy,Physiology&ItsImportance,   EffectofexerciseonthefunctioningofVariousBodySystems
(CirculatorySystem,RespiratorySystem,Neuro-MuscularSystemetc.),   MeaningandConceptofPostures,
CausesofBadPosture, Advantages&disadvantagesofweighttraining., Concept&advantagesofCorrectPosture,
CommonPosturalDeformities–KnockKnee;FlatFoot;RoundShoulders;Lordosis,
Kyphosis,BowLegsandScoliosis, CorrectiveMeasuresforPosturalDeformities.

Unit 3: Yoga&Lifestyle(6 Lectures)
ElementsofYoga,   Introduction-Asanas,Pranayama,Meditation&YogicKriyas,
Yogaforconcentration&relatedAsanas,   RelaxationTechniquesforimprovingconcentration   -Yog-nidra,
Asanasaspreventivemeasures.

Unit 4: Training, Planning &PsychologyinSports(8 Lectures)
MeaningofTraining,   warmingupandlimberingdown,   Skill,Technique&   Style,
MeaningandObjectivesofPlanning, Tournament–Knock-Out,League/RoundRobin&Combination.
Definition&ImportanceofPsychologyinPhysicalEdu.&Sports,
Define&DifferentiateBetweenGrowth&Development,   AdolescentProblems&TheirManagement,
Psychologicalbenefitsofexercise.

TextBooks/References:
1. Ajmer Singh and Rachhpal Singh Brar, 2019, Essentials ofPhysicalEducation, Kalyani Publishers.
2. B.K.S.Iyengar, 2015, Yoga for Sports, Westland publications.

Evaluation Tools:
Class Quiz, Rubrics
           MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
                (Deemed to be University under section 3 of the UGC Act 1956)

BHM-MC-006: Quantitative Aptitude and Personality Development-I

Periods/week   Credits   Max. Marks   : 100
P :2   AP   Internal/Continuous Evaluation : 50
Duration of Exam: 2 Hrs   End Semester Exam   : 50

Pre-Requisite: Nil
Course Type: HSMC

Course Outcomes: After completion of this course the students will be able to
BHM-MC-006.1. recognize& solve problems based on non-verbal reasoning.
BHM-MC-006.2. solve complex problems based on arithmetic reasoning.
BHM-MC-006.3.apply short tricks on complex problems of verbal reasoning.
BHM-MC-006.4. apply correct usage of grammar in communication.
BHM-MC-006.5. enhance their vocabulary and use it in day to day life.
BHM-MC-006.6. develop speed reading & writing skills.

PART – A
Unit 1: Arithmetic II
1.1 Percentages
1.2 Ratio & Proportion
    1.2.1.   Proportionality
    1.2.2. Variations
    1.2.3 Partnership
1.3 Profit & Loss
    1.3.1. Basic terminology & Formulae
    1.3.2. Error in Weights
    1.3.3. Marked Price and Discounts
1.4Time & Work
       1.4.1. Time and Work, Chain Rule
       1.4.1. Work & Wages
       1.4.2. Pipes & Cisterns
1.5 Mixtures &Alligations

Unit 2: Verbal Reasoning 2

    2.1 Syllogism
    2.2 Ranking
    2.3 Coding-Decoding
    2.4Inequalities and Mathematical Operations

Unit 3: Non Verbal Reasoning
    3.1 Pictorial Series
    3.2 Missing Values
    3.3 Analogy and Images

Part B
Unit 4: Communication Accuracy
    4.1 Relevance of Verbal Ability and preparatory guidelines
    4.2 Functional Grammar – Subject Verb Agreement
    4.3 Tenses – Perfect, Simple, Continuous
    4.4 Common Errors and rectification

Unit 5: Word Power Building Skills

5.1 Words: Antonyms, Synonyms, Verbal Analogies

5.2 Compound words: Homophones, Homonyms, Word Families

5.3 Root Word Technique for Prefixes & Suffixes

5.4: Word Power: 7 Tips for Learning New Words

5.5 Practice Vocabulary Exercises

Unit 6: Reading & Writing Skills

6.1 Objectives of Reading, Definition & Types of Reading & Importance of Reading

6.2 Reading Techniques: SW3R, Active Reading, Detailed, Speed

6.3 Practice Exercises: Short & Medium Passages3.1 Writing: Introduction of Writing Skills, Objectives of enhancing Writing Skills & Types of Writing

6.4 Sentences, Phrases, Types of Sentences, Parts of Sentences

6.5 Paragraph Writing: Construction, Linkage & Cohesion

Text Books/Reference Books:

1. R S Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations: S Chand & Company PvtLtd.
2. R S Aggarwal, 2018, A Modern Approach to Verbal&Non Verbal Reasoning: S Chand & Company Pvt Ltd.
3. Mvn, 2015,Verbal Ability and Reading Comprehension: MVN Enterprises.
4. P.A. Anand ,Lalit Singh, 2016, Wiley Verbal Ability and Reasoning for Competitive Examinations, Wiley.

Instructions for paper setting: Fifty MCQ will be set in total. Twenty five MCQ will be set from Part A and twenty five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Continuous Evaluation:

Sessionals   - 30 Marks
Assignments   - 10 Marks
Class Work/Performance - 05 Marks
Attendance   - 05 Marks

Distribution of Continuous Evaluation:

Sessional- I	15%
Sessional- II	15%
Assignment/Tutorial	10%
Class Work/ Performance	5%
Attendance	5%

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BHM-MC-006.1	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1	1
BHM-MC-006.2	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
BHM-MC-006.3	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1	1
BHM-MC-006.4	1	-	-	1	-	-	-	-	1	3	-	2	1	1	1	1
BHM-MC-006.5	1	-	-	1	-	1	-	-	1	3	-	2	-	-	1	1
BHM-MC-006.6	1	2	-	1	1	1	1	1	1	3	1	2	1	1	1	1

5thSEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-501A: RECOMBINANT DNA TECHNOLOGY

Periods/week Credits	Max. Marks	:200
L: 3 T: 0 3	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs	End Semester Examination	:100

Pre-requisites: Molecular Biology (BBT-DS-401)
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-501A.1 explain and classify the various tools, techniques and approaches in creating a recombinant DNA molecule.
BBT-DS-501A.2 appraise the use of genetic engineering concepts and technologies in current applications of biotechnology.
BBT-DS-501A.3 employ their creative potential in investigating and developing new ideas in genetic engineering based projects.
BBT-DS-501A.4 gain knowledge about safety and ethical use of rDNA technology.

PART-A

Unit 1: Introduction to recombinant DNA technology
1.1 History of recombinant DNA technology
1.2 Restriction endonucleases, Ligases
1.3 Phosphates, Methylases, Kinases
1.4 Adaptor, linker, DNA probes.

Unit 2: Cloning Vectors
2.1 Plasmid cloning vector
2.2 Cosmids, Phage vectors, Phagemids
2.3 Molecular basis of lysogeny and lytic life cycle
2.4 Shuttle vectors, Baculovirus vector system, YAC and BAC vectors
2.5 Ti plasmid derived vector systems

Unit 3: Gene Library
3.1 Construction cDNA library and genomic library,
3.2 Screening of gene libraries – screening by DNA hybridization.
3.3 DNA sequencing-Maxam Gilbert, Sanger dideoxy method and automated DNA sequencing.
3.4 Introduction to Next Generation Sequencing

Unit 4: DNA Delivery

4.1 Physical methods and biological methods,

4.2 Site Directed mutagenesis

4.3 Transposon tagging

4.4 Genome editing Technologies

Unit 5: Advanced Technologies

5.1 Gene expression in prokaryotes

5.2 Gene Expression in Eukaryotes

5.3 Southern, Northern and Western Blotting

5.4 PCR- Principles and Types

5.5 Applications of advanced technologies

Unit 6: Applications of RDNA Technology and Public Concern

6.1rDNA-Production of therapeutic proteins-insulin and human growth hormones

6.2 Human gene therapy-types, methodology, limitation and application, gene silencing,

6.3 Transgenic plants and animals.

6.4 Ethical Guidelines, Regulations and Public concern with rDNA Technology

Text Books/Reference Books:

1. R.W. Old, S.B. Primrose, 1995, Principles of Gene manipulation, An introduction to Genetic engineering, Blackwell Scientific Publications.
2. T.A. Brown, 2001, Gene Cloning, Wiley Blackwell Publication.
3. Bruce Alberts, J.D. Watson, 2009, Molecular Cell Biology: Garland Publication.
4. Cooper, 2008, The cell – a molecular approach, A.S.M. Press Publication.

Web links:

http://nptel.ac.in/courses/102103013/

http://nptel.ac.in/courses/102103041/

http://nptel.ac.in/courses/102103013/

http://nptel.ac.in/courses/102103013/10

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO (BBT-DS-501A)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BBT-DS-501A.1	3	3	2	2	2	1	-	-	1	2	1	2	3	3	2	-
BBT-DS-501A.2	3	3	3	3	3	2	2	-	2	1	3	3	2	2	1	1
BBT-DS-501A.3	3	1	-	2	2	-	-	-	2	1	2	1	-	1	1	-
BBT-DS-501A.4	3	3	2	2	2	2	2	2	2	1	3	2	2	2	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University Under Section 3 of the UGC Act 1956)

BBT-DS-502: FOOD BIOTECHNOLOGY

Periods/week Credits	Max. Marks	: 200
L: 3 T: 0 3	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs	End Semester Examination	: 100

Pre-requisites: Knowledge of basic 10+2 science
Course Type: Core

Course Outcomes:

Course Outcomes:

The students will be able to-
BBT-DS-502.1 identify and explain the presence and detection of various microbes associated with food.
BBT-DS-502.2 describe techniques that can be used to monitor quality of raw ingredients and final products.
BBT-DS-502.3 apply principles from the various facets of food biotechnology to solve practical, real-world problems such as the effects of common food preservation and production methods, and food storage conditions, on survival and growth of microbial contaminants.
BBT-DS-502.4 assess the utilization of food waste for production of valuables

PART-A

Unit 1: Introduction
1.1 Sources, types, incidence, and behavior of microorganisms in food
1.2 Primary sources of Microorganisms found in foods
1.3 Common food-borne bacteria
1.4 Genera of molds common to foods
1.5 Genera of yeasts common to foods

Unit 2: Factors affecting food:
2.1 Intrinsic and extrinsic microbial parameters of foods
2.2 Determination and detection of microorganism in food
2.3 SPC, Membrane Filters, Microscopic Colony Counts
2.4 Agar droplets, Dry films, MPN, DMC, Dye reduction and Roll Tubes
2.5 Microbiological examination of surfaces and their sampling

Unit 3: Spoilage technology
1.1 Spoilage of fruits and Vegetables
1.2 Spoilage of Fresh and Processed Meats
1.3 Spoilage of Poultry and Sea foods
1.4 Spoilage of Miscellaneous Foods

PART-B

Unit 4: Preservation Technology
4.1 Food preservation: High and Low Temperature
4.2 Drying, Characteristics of Radiations of Interest in Food Preservation
4.3 Food additives li-colouring, flavours and vitamins
4.4 Organisms and their use in pickling, producing colour and flavours
4.5 Alcoholic beverages and other products

Unit 5: Food Production technology
3.1 Microbial role in food process operations and production
3.2 Fermentative production of food and alcoholic beverages
3.3 Single cell protein (mushroom, food yeast's, algal proteins)

Unit 6: Technology for improved process
1.1 Technology for improved process
1.2 Enzyme in bakery and cereal products
1.3 Enzymes in fat/oil industries
1.4 Protease in cheese making and beverage production
1.5 Utilization of food waste for production of valuables

Text Books/Reference Books:
1. Palmer, 2001, Enzymes, Horwood Publishing Series.
2. J.M. Jay, 1986, Modern Food Micro-biology, Van Nostrand Reinhold company, New York.
3. W. Gerhartz, 1990, Enzymes in Industry: Production and Applications, VCH Publishers, New York.
4. N.C. Price and Lewis Stevens, 2012, Fundamentals of Enzymology, Oxford Univ. Press.

Web links:
http://nptel.ac.in/courses/103103029/34
http://nptel.ac.in/courses/103103029/35
http://nptel.ac.in/courses/103107088/module1/lecture1/lecture1.pdf

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-502)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BBT-DS-502.1	2	3	2	2	3	2	-	-	1	1	2	2	3	2	3	2
BBT-DS-502.2	3	2	1	1	2	2	-	-	1	1	2	3	3	3	2	1
BBT-DS-502.3	2	3	1	2	2	2	-	-	2	1	2	1	2	2	1	1
BBT-DS-502.4	3	3	1	2	2	1	1	-	2	1	3	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-503: ANIMAL BIOTECHNOLOGY

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3	Continuous Evaluation : 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination: 100

Pre-requisites: Cell Biology (BBT-DS-301)
Course Type: Core

Course Outcomes:
The students will be able to:
BBT-DS-503.1 describe the principles, practices and applications of animal biotechnology.
BBT-DS-503.2 appreciate the relevance of in vitro techniques used in animal biotechnology.
BBT-DS-503.3 apply fundamental principles of maintaining cell lines in various application fields
BBT-DS-503.4 propose scientific and ethical considerations of cell culture techniques for applications in healthcare.

PART-A

Unit 1: Basics of Animal cell culture
1.1 Introduction, history, and scope of animal biotechnology
1.2 Facilities and equipment in animal cell culture lab
1.3 Preparation of animal cell growth media and maintenance medium
1.4 Serum – source, quality, and its uses
1.5 Serum free medium
1.6 Contamination and detection of contamination
1.7 Preservation and maintenance of animal cell lines

Unit 2: Primary cell culture, immortalization, characterization
2.1 Primary culture
2.2 Establishment of immortal cell lines
2.3 Quantitation of cell growth and other parameters
2.4 Cell Separation
2.5 Characterization

Unit 3: Specialized animal cell culture techniques
3.1 Preparation of hybridoma cells
3.2 Production of monoclonal antibodies
3.3 Cell Synchronization
3.4 Gene cloning techniques for mammalian cells
3.5 Expression of genes in animal cells

PART-B

Unit 4: Applications of animal cell culture and scale-up
4.1 Applications of animal cell culture technology
4.2 Cell lines as model systems
4.3 Cytotoxicity testing
4.4 Three Dimensional Culture

4.5 Tissue Engineering
4.6 Cell culture Bioreactors

Unit 5: Transgenic Animals
5.1 Transgenic animal models
5.2 Transfection and transformation
5.3 Methodology for making transgenic animals - Retroviral vector method, DNA microinjection method and engineered embryonic stem (ES) cell transfer method
5.4 Cloning by nuclear transfer method
5.5 In-vitro fertilization
5.6 Embryo transfer

Unit 6: Stem cells and their applications
6.1 Stem cell biology
6.2 Stem cell cultures
6.3 Embryonic stem cells and their applications
6.4 Adult stem cells and their applications
6.5 Induced pluripotent stem cells
6.6 Ethical considerations in applications of cell culture technology

Text Books/Reference Books:
1. R. Ian Freshney, 2007, Culture of Animal Cells, Wiley and Sons Publication.
2. R.W. John Masters, 2011, Animal Cell Culture – Practical Approach, Oxford Publication.
3. Murray Moo Young, 1998, Animal Biotechnology: Comprehensive Biotechnology, Pergamon Publication.
4. A. Maureen, 2003, General Techniques of Cell Culture, Handbooks in Practical Animal Cell Biology, Cambridge University Press.

Web links:
http://nptel.ac.in/courses/102103012/pdf/mod6.pdf
http://nptel.ac.in/courses/102103041/9
http://nptel.ac.in/courses/102103013/23

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-503)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-503.1	-	1	1	2	-	2	2	2	1	2	-	2	2	2	2	3

BBT-DS-503.2	-	1	1	2	-	2	2	2	1	2	-	2	2	2	2	2
BBT-DS-503.3	1	1	1	2	1	2	2	2	2	2	1	2	2	2	2	2
BBT-DS-503.4	1	1	1	2	1	2	2	2	2	2	1	2	3	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BBT-DS-504 :Entrepreneurship & Start-Ups

Periods/week	Credits	Max. Marks	: 200
L: 2 T: 0	2	Continuous Evaluation	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100	

Pre-requisites: None
Course Type: _____

Course Outcomes:
The students will be able to:
BBT-DS-504.1 understand the dynamic role of entrepreneurship and small businesses.
BBT-DS-504.2 develop entrepreneurial spirit, competency, motivationand resourcefulness.
BBT-DS-504.3 acquire the skills of creation and management of entrepreneurial venture.
BBT-DS-504.4appraise the contribution of entrepreneurship in the growth and development of individuals and the nation.

PART-A

Unit 1: Introduction to Entrepreneurship and Start – Ups

Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation
Types of Business Structures, Similarities/differences between entrepreneurs and managers.

Unit 2: Business Ideas and their implementation
Discovering ideas and visualizing the business, Activity map,
Business Plan

Unit 3: Idea to Start-up
Market Analysis – Identifying the target market,Competition evaluation and Strategy Development, Marketing and accounting,Risk analysis

PART-B
Unit 4: Management
Company's Organization Structure,Recruitment and management of talent, Financial organization and management

Unit 5: Financing and Protection of Ideas
Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses

Unit 6:Business strategies
Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy.
Case studies on Start-ups.

Text Books/References:

1. H.Weihrich,M.V. Cannice and H.Koontz, Management – A Global and Entrepreneurial Perspective, McGraw Hill
2. V.Sathe, Corporate Entrepreneurship, Cambridge University Press
3. Gilbert: Principles of Management, McGraw Hill.
4. J.Greenberg and R.A.Baron, Behaviour in Organisations, Prentice Hall
5. S.L. Mc Shane , M.A.von Glinow &R.R Sharma, Organisational Behaviour; Tata McGraw Hill.
6. S.P.Robbins&M.Coulter, Management, Pearson.
7. Stoner & Wankel: Management, Prentice Hall of India.

Weblinks:

https://www.fundable.com/learn/resources/guides/startup
https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/
https://www.finder.com/small-business-finance-tips
https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-504.1	3	3	2	2	2	-	-	-	1	-	-	2	3	3	2	-
BBT-DS-504.2	3	3	3	3	3	2	2	-	2	1	3	3	2	2	1	1
BBT-DS-504.3	3	1	-	2	2	-	-	1	2	1	2	1	2	1	1	2
BBT-DS-504.4	3	3	2	2	2	2	2	1	2	1	3	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BBT-DS-551A: RECOMBINANT DNA TECHNOLOGY LAB

Periods/week Credits	Max. Marks :100
P: 3 1.5	Continuous Evaluation : 50
Duration of Ext. Exam: 3 Hrs	End Semester Examination: 50

Pre-requisites: Molecular Biology Lab (BBT-DS-451)
Course Type: Core

Course Outcomes:
The students will be able to-
BBT-DS-551A.1 learn the isolation of genomic DNA and plasmid DNA from the host.
BBT-DS-551A.2 reproduce the basic steps involved in cloning a gene of interest in a particular host and do screening.
BBT-DS-551A.3 analyze the restriction maps developed by using different restriction enzymes.
BBT-DS-551A.4 perform and analyze the various techniques like PCR, Northern, Southern and Western blotting.

List of Experiments:

1. Isolation of genomic DNA from the target organism
2. Plasmid isolation from the host.
3. Preparation of the vector for cloning
4. To observe the ligation of target gene in vector
5. To study the Competent cell preparation
6. To study transformation of ligated construct.
7. Induction of the target gene expression
8. To screen the cloned colonies
9. To study and perform the technique of Northern blotting.
10. To study and perform the technique of Southern blotting.
11. To study and perform the technique of Gel Drying.
12. To learn Restriction Mapping.
13. To learn Primer Designing
14. To learn the technique of PCR
15. To learn RT-PCR.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Reference Books:
1. J. Sambrook and D.W. Russell, 2013, Molecular Cloning- a laboratory manual, Cold Spring Harbor Laboratory Press Publication, New York

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-551A)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BBT-DS-551A.1.	1	1	-	1	-	1	-	-	1	-	-	2	2	2	1	-
BBT-DS-551A2.	1	1	1	1	-	1	-	-	2	1	-	2	3	2	2	-
BBT-DS-551A.3.	1	1	-	2	-	-	-	-	2	1	2	1	2	1	1	-
BBT-DS-551A.4.	1	1	2	2	2	2	1	1	1	1	1	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-552: FOOD TECHNOLOGY LAB

Periods/week   Credits   Max. Marks   :100
P: 3   1.5   Continuous Evaluation   : 50
Duration of Ext. Exam: 3 Hrs   End Semester Examination: 50

Pre-requisites:knowledge of basic 10+2 science
Course Type: Core

Course outcomes:
The students will be able to-
BBT-DS-552.1: estimate the microbiological quality of various food items.
BBT-DS-552.2: appreciate the importance of detection methods employed for food items.
BBT-DS-552.3: appraise the principle and processes in production of various food items.
BBT-DS-552.4: assimilate the practical knowledge to solve food related problems of real world.

List of Experiments:
1. Determination of microbiological quality of water.
2. Presumptive and confirmatory tests for coli form bacteria in water.
3. Microbiological quality of processed milk.
4. Microbiological quality of dehydrated foods.
5. Microbiological examination of spoiled food.
6. Production of alcohol by fermentation.
7. To study the industrial production of alcohol from molasses
8. Production of Curd and examination of its microbiological quality.
9. To study the process of production of Brewer/Baker/Folder yeast.
10. To study and demonstration of the process of yogurt manufacture plant.
11. To study and demonstration of process of pasteurization to improve the storage quantities of milk, fruit juice and other food items.
12. To study the various physical methods such as heat, cold, dehydration, high osmotic pressure etc for preservation of food.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Reference Books:
1. J.M. Jay, 1986, Modern Food Micro-biology, Van Nostrand Reinhold company, New York.
2. W. Gerhartz, 1990, Enzymes in Industry: Production and Applications, VCH Publishers, New York.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-552)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-552.1	2	2	2	2	2	2	2	1	1	2	1	1	1	3	2	1
BBT-DS-552.2	2	2	1	2	2	2	2	1	1	2	1	1	1	2	2	1
BBT-DS-552.3	2	1	1	2	2	2	3	1	1	2	1	1	1	3	2	1
BBT-DS-552.4	2	2	2	2	2	2	2	1	1	2	1	1	1	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956**)**
DTI-500: Design, Thinking and Innovation – III

Periods/week   Credits   Max. Marks   : 50
P: 1   2.0   Continuous Assessment : 50

Pre-requisites: Research and Innovation Catalyst-II
Course Type: Research & Training
Course Coordinator: Research Mentor

Course outcomes
The students will be able to**:**
 RIC (E)-500.1. Understand the Plagiarism / Feasibility tools
 RIC (E)-500.2. Document the outcome as Research Paper / Patent / Product / Start-up /copyright

Activity 1:
        1.1 Compilation / Documentation of the outcome (Research Paper / Patent / Product / Start-up /copyright).
        1.2 Plagiarism / Feasibility check.
        1.3 Identification of the suitable Journal / Patenting Agencies / Angel Investors.
        1.4 Submission to the identified Journal / Patenting Agencies / Angel Investors.

Course Articulation Matrix:

CO Statement (XX-500)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO4
DTI-500.1	3	3	1	1	1	1	3	3	3	3	1	3	3	1	1	2
DTI-500.2	2	3	2	3	3	3	2	3	2	2	3	3	3	3	2	2

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No.	Parameters	Description	(Marks)
1.	**Attendance**	• Percentage of classes attended by the students	**5**
2.	**Continuous Performance**	• Judge individual student's participation in the Activities • Time bound completion of Activities	**15**
3.	**Accomplishment of the Outcome**	• Quality of the content and results • Acceptance of the outcome (Research Paper/ Patent/ Product/ Copyright) • Report submission / Presentation	**30**

References:
1. www.originlab.com
2. http://www.cambridgesoft.com/software
3. http://www.synergy.com/
4. www.mathworks.com/products/matlab.html

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

BHM-MC-008: Quantitative Aptitude& Personality Development II

Periods/week   Credits
P:2   T:0   AP
Duration of Exam: 2hrs

Max. Marks   : 100
Continuous Evaluation   : 50
End Semester Examination(Written)   : 50

Pre-requisites:none
Course Type: HSMC

Course Outcomes:
Students will be able to
BHM-MC-008.1 analyze various forms of data.
BHM-MC-008.2 solve complex problems based on arithmetic reasoning.
BHM-MC-008.3 apply short tricks on complex problems of number system.
BHM-MC-008.4 enhance and expand word knowledge by fostering word consciousness.
BHM-MC-008.5 construct simple and complex sentences accurately.
BHM-MC-008.6 develop reading skills & build verbal reasoning skills.

PART – A

Unit 1: Number System II
1.4 Factors and Multiples
1.5 Unit Digits &Cyclicity
1.6 Remainders
1.7 Factorials
1.8 Logarithm

Unit 2: Arithmetic III
2.1 Interest
        2.1.1 Simple Interest
        2.1.2 Compound Interest
        2.1.3   Relation between SI & CI
2.2 Time, Speed & Distance
        2.2.1 Basics Formulas & Proportionality
        2.2.2 Average & Relative Speed
        2.2.3 Trains and Boats & Streams
        2.2.4 Circular Motion and Clocks
2.3Data Interpretation
        2.3.1 Table and Bar graph
        2.3.2 Line and Pie Charts
        2.3.1 Mixed Charts and Caselets

Unit 3: Verbal Reasoning III
        3.1 Calendar
        3.2 Cubes and Dices
        3.3 Data Sufficiency

PART – B

Unit 4: Advanced Vocabulary
4.1 Synonym & Antonym
4.2 One Word Substitution
4.3 Ordering of Words
4.4 Idioms and Phrases
4.5 Vocabulary, COW, Punctuation

Unit 5: Sentence Construction & Syntax
5.1 Sentence Improvement
5.2 Spotting Errors
5.3 Ordering of Sentences
5.4 Change of Voice/ Direct & Indirect speech
5.5 Completing Statements/Sentences

Unit 6: Reading Comprehension & Reasoning
6.1 Strategic Reading, Eliminating Poor Reading Habits
6.2 Techniques to increase speed reading, comprehension and recall
6.3 Solving Sample RC Passages
6.4 Closet Test
6.5 Para Jumbles

Text Books/Reference Books:
1. R S Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations: S Chand & Company Pvt Ltd.
2. R S Aggarwal, 2018, A Modern Approach to Verbal& Non Verbal Reasoning, S Chand & Company Pvt. Ltd.
3. P.A. Anand, 2017, Verbal Ability and Reasoning for Competitive Examinations, Wiley

Instructions for paper setting: Fifty MCQ will be set in total. Twenty five MCQ will be set from Part A and twenty five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Continuous Evaluation:
Sessional - 30 Marks
Assignments - 10 Marks
Class Work/Performance - 05 Marks
Attendance - 05 Marks
Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO (BHM-MC-008)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BHM-MC-008.1	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-

BHM-MC-008.2	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-
BHM-MC-008.3	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-
BHM-MC-008.4	1	-	1	-	-	-	-	-	1	3	1	2	1	-	2
BHM-MC-008.5	1	-	1	1	-	1	-	-	1	3	1	2	1	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

PROJ-BT-500: SUMMER INTERNSHIP II

Credits: 2

Max. Marks :100
Continuous Evaluation: 100

Pre-requisites: None

Each student is required to accomplish at least 4 Weeks of Internship/ Training at the end of Fourth Semester and before the commencement of Fifth semester, i.e. in the month of June- July. The training shall be conducted outside the institution and shall aim to hone the skills of students. The students can opt for training at a research organization or a reputed industry related to the domain of Biotechnology. The evaluation of this Internship/ training is to be done as continuous Evaluation based on their regularity and overall performance during the Internship. The marks of this evaluation shall be included in the result of Fifth Semester.

HM-506 : French-1

Periods/week	Credits	Max. Marks	: 100
L: 2 T: 0	2.0	Continuous Evaluation	: 50
Duration of Examination: 1.5 Hrs		End Sem Examination	: 50

Pre-Requisite: Basic knowledge of grammatical structure, syntax, and vocabulary of English and/or Hindi.

Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-

HM-506.1. Exchange greetings and do introductions using formal and informal expressions. They can understand and use interrogative and answer simple questions.

HM-506.2. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greeting, weather and daily activities,) with repetition when needed.

HM-506.3.Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.

HM-506.4. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary. Provide basic information about familiar situations and topics of interest.

HM-506.5. Express or/and justify opinions using equivalents of different verbs. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture.

HM-506.6. Describe various places, location, themselves using simple sentences and vocabulary.

PART-A

Unit 1- Saluer et épeler l'alphabet
1.1 Les Salutations & forms of politeness
1.2 Alphabets

Unit 2- Usage de Vous et de Tu
2.1 Taking leave expressions
2.2 Les pronoms sujets
2.3 Basic Questions

Unit 3- Présentez-vous
3.1 Les verbes ER
3.2 Self introduction
3.3 Décrivez votre ami(e)

PART-B

Unit 4- Identifier un nombre, compter
4.1 Les noms
4.2 Verbes Avoir, Etre, Aller & Faire
4.3 Les nombres

Unit 5- Demander/ donner l'explications
5.1 Les articles define et indefini
5.2 Les mois de l'annee
5.3 Les jours de la semaine

Unit 6- Parler des saisons et demander l'heure
6.1 Time
6.2 Weather
6.3 Unseen Passage

Text Books/Reference Books/ Suggested Readings:
1. Alter Ego Level One Textbook: Annie Berthet, Catherine Hugot, Veronique M Kizirian, 2006, Hachette Publications.
2. Apprenons Le Francais II & III: Mahitha Ranjit, 2014, Saraswati Publications.

Weblinks:
www.bonjourfrance.com
www.allabout.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM–506)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HM-506.1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-506.2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-506.3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-506.4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-506.5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-506.6	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

HM-507 : German-1

Periods/week Credits	Max. Marks : 100
L: 2 T: 0 2.0	Continuous Evaluation : 50
Duration of Examination: 1.5 Hrs	End Sem Examination : 50

Pre-Requisite: Basic knowledge of grammatical structure, syntax, and vocabulary of English and/or Hindi.

Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-

HM-507.1. Exchange greetings and introductions using formal and informal expressions. They will be able to ask and answer simple questions.

HM-507.2. Discuss everyday life and daily routines, using simple sentences and familiar vocabulary.

HM-507.3. Identify key details in short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed.

HM-507.4. Discuss likes and dislikes, understand simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed

HM-507.5. Differentiate certain patterns of behavior in the cultures of the German- speaking world and the student's native culture.

HM-507.6. Describe various places, location, themselves using simple sentences and vocabulary.

PART-A

Unit-1: Begrüßungen
1.1 Salutations/Greetings
1.2 Introduction

Unit-2: sich vorstellen und Zahlen
2.1 Introduction
2.2 Alphabets
2.3 Numbers 1-20

Unit-3: Berufe/ Pronomen
3.1 Personal pronouns
3.2 Hobbies and professions

PART-B

Unit-4:Café
4.1 Café related vocabulary and dialogues
4.2 Revision personal pronouns

Unit-5: Café dialog
5.1 Café related vocabulary and dialogues
5.2 Common verbs and their conjugations

Unit-6: Zeit und Monate
6.1 Time
6.2 Days
6.3 Months

Text Books/Reference Books:
1. Studio D A1: Hermann Funk, 2011, Cornelson Publication.
2. Tangaram Aktuell A1: Kursbuch & Arbeitsbuch, 2011, Hueber.
3. Netzwerk: Stefanie Dengler, Paul Rusch, 2011, Klett.

Weblinks:
http://www.nthuleen.com/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM–507)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HM-507.1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-507.2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-507.3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-507.4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-507.5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-507.6	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1

HM-508 : Spanish-1

Periods/week Credits	Max. Marks : 100
L: 2 T: 0 2.0	Continuous Evaluation : 50
Duration of Examination: 1.5 Hrs	End Sem Examination : 50

Pre-Requisite: Basic knowledge of grammatical structure, syntax, and vocabulary of English and/or Hindi.

Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-
  HM-508.1. Exchange greetings and introductions using formal and informal expressions and students will be able to ask and answer simple questions.
  HM-508.2. Discuss everyday life and daily routines, using simple sentences and familiar vocabulary and students will be able to discuss likes and dislikes understand simple conversations about familiar topics.
  HM-508.3. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed and students will be able to offer basic descriptions of self, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.
  HM-508.4. Provide basic information about familiar situations and topics of interest and students will be able to express or/and justify opinions using equivalents of different verbs.
  HM-508.5. Differentiate certain patterns of behavior in the cultures of the Spanish-speaking world and student's native culture.
  HM-508.6. Describe various places, location, themselves using simple sentences and vocabulary.

PART-A
Unit 1: Introduction to Spanish and SER
1.1 Presentation on Spanish language
1.2 Greetings and goodbyes
1.3 Spanish letters
1.4 Introduction of Verbo SER

Unit 2: Verb Ser, Nationality, Profession and Counting
2.1 Uses of Verbo SER
2.2 Adjectives related to Verbo SER.
2.3 Introduction of Nationality
2.4 Professions and vocabulary related to professions.
2.5 Counting till number 20.
PART-B
Unit 3: Articles, Interrogative and Estar
3.1 Introduction of Articles and Indefinite articles
3.2 Interrogatives
3.3 Introduction of Verbo Estar

Unit 4:Estar, Preposition, Tener and Self Introduction
4.1 Uses of Verbo ESTAR and adjectives related to it
4.2 Prepositions related to the positioning of an object
4.3 Tener & its uses
4.4 Self – introduction

Unit 5 : Day, Month and Regular AR verb
5.1 Days
5.2 Months
5.3 Introduction to regular –AR verbs

Text Books/Reference Books:
1. Spanish Grammar: Eric V Greenfield, 1971, Barnes and Noble.
2. Nuevo Espanol sin fronteras 1 + Workbook + CD: Jesus Sanchez Lobato and Isabel Santos Gargallo, 2006, Goyal, Ele & Sgel.

Weblinks:
http://studyspanish.com/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM-508)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HM-508.1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-508.2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-508.3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-508.4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-508.5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-508.6	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BBT-DS-524: BIOSIMILARS TECHNOLOGY

Periods/week Credits		Max. Marks : 200
L: 3 T: 0 3		Continuous Evaluation : 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcomes:
The students will be able to-
BBT-DS-524.1 develop a perspective of the complexity to establish biosimilarity of therapeutic proteins and biologics.
BBT-DS-524.2 describe the design and development of different kinds of biologics, biomimetics and biosimilars.
BBT-DS-524.3 evaluate different biotechnological applications of biosimilars.
BBT-DS-524.4 understand the regulatory framework about the biosimilars.

PART-A

Unit 1: Introduction to Biopharma
Generics in Biopharma, definition of biologics, biosimilars, super biologics, differences between chemical genetics and biosimilars, The developmental and regulatory challenges in biosimilar development, Prerequisites for Biosimilar development, Biosimilar market potential.

Unit 2: Types of biosimilar drugs
Peptides, proteins, antibodies, Enzymes, Vaccines, Nucleic acid based therapies (DNA, RNA, etc), Cell based therapies (including stem cells)

PART B

Unit 3: Biochemical Characterization
Aggregation- precipitation, floccule strength, precipitate ageing & kinetics, adsorption of proteins & peptides on surfaces, effect of temperature on protein structure, hydration & thermal stability of proteins - solid powders, suspension on non-aqueous solvents, reversed micelles, aqueous solution of polyols,

Unit 4: Structural and Compositional Analysis
Analytical and spectrophotometric characterization of proteins, protein sequencing and structure determination

Unit 5: Bioequivalence studies
Immunogenicity &allergenicity of biosimilars; factors affecting immunogenicity - structural, post-translational modifications, formulations, impurities, manufacturing and formulation methods for biosimilars; Types of bioequivalence (average, population, individual), experimental designs & statistical considerations for bioequivalence studies (Non-replicated designs – General Linear Model, Replicated crossover designs),introduction to "ORANGE BOOK" & "PURPLE BOOK".

Unit 6: Case studies

Indian companies working in this space & their product pipeline (Biocon, Intas, Dr. Reddy's, Reliance, Bharat Biotech, Lupin, Cipla, Shanta, etc); products - Erythropoietin, growth hormone, granulocyte stimulating factors, interferons, streptokinase, monoclonal antibodies.

Text Books/References:

1. L. Endrenyi, P. Declerck and Shein-Chung Chow, Biosimilar Drug Development, Drugs and Pharmaceutical Sciences, CRC Press.

2. C. Liu and K. John Morrow Jr.,2016, Biosimilars of Monoclonal Antibodies: A Practical Guide to Manufacturing, Preclinical and Clinical Development, Wiley.

Weblinks:
https://www.drugs.com/medical-answers/many-biosimilars-approved-united-states-3463281/

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PS O 4
BBT-DS-524.1	3	2	3	3		2	2		2	1	2	1	2	2	1	
BBT-DS-524.2	3	3	3	3	1		1	1	1	2	2	1	1			1
BBT-DS-524.3	3	2	2	3	2	1	1	1			1	1	2		1	
BBT-DS-524.4	1	2		1	2		1	2			1	1	1	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-525: GENOMICS & PROTEOMICS

Periods/week   Credits   Max. Marks   : 200
L: 3   T: 0   3   Continuous Evaluation   : 100
Duration of Ext. Exam: 3 Hrs   End Semester Examination: 100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcomes:
The students will be able to-
BBT-DS-525.1   interpret the comparative, functional and evolutionary aspects of genomics.
BBT-DS-525.2   apply the tools and techniques used in genomics and proteomics
                     systems.
BBT-DS-525.3   analyze features of genomic and proteomic data
BBT-DS-525.4   design genetic manipulation strategies for deriving solutions to complex problems of
                     human beings

PART-A

Unit 1: Introduction to Genomics
1.1 Genetics to genomics
1.2 Functional genomics
1.2 Orientations and structure of genomes
1.3 Subdividing the genome
1.4 Assembling the physical map of a genome
1.5 Genome sequencing projects

Unit 2: Comparative Genomics
2.1 Introduction to Comparative Genomics
2.2 Evolutionary Genomics
2.3 Multigene families in the genome
2.4 Genome annotation and bioinformatics
2.5 Molecular phylogenetics and applications

Unit 3: Metagenomics
3.1 Introduction to metagenomics
3.2 Designing a metagenomic project
3.3 Habitat selection,and sampling strategy
3.4 Macromolecular recovery
3.5 6S rRNA based analysis

PART-B

Unit 4: Tools and techniques in Proteomics
4.1 Protein Identification and Analysis
4.2 Protein Identification by mass spectrometry
4.3 Application of Microarray in proteome analysis

4.4 Proteins Arrays and Protein Chips
4.5 Various tools used in proteomics.

Unit 5: Mapping Protein Interactions and Applications
5.1 Global expression profiling
5.2 Comprehensive mutant libraries
5.3 Mapping protein interactions: Yeast two hybrid and phage display
5.4 Applications of genome and proteome analysis

Unit 6: Applications of Proteomics and Pharmacogenomics
6.1 Introduction to Pharmacogenomics
6.2 High throughput screening in genome for drug discovery
6.3 Identification of gene targets
6.4 Pharmacogenomics and drug development
6.5 Proteomics Tools and Databases

Text Books/Reference Books:
1. G. Gibson and S. V. Muse, 2009,A Primer of Genome Science,Third Edition, , Oxford University Press.
2. J. D. Watson, M. Gilman, J. A. Witkowski and M. Zoller, 1993,Recombinant DNA, Second Edition, , The University of Chicago Press Journals.
3. S. B. Primroseand R. Twyman, 2014, Principles of Gene Manipulation and Genomics, 7th edition, Blackwell Publishing.
4. S.P. Hunt and R. Livesey , 2000, Functional Genomics – A Practical Approach, , Oxford University Press.
5. C.W. Sensen ,2002, Essential of Genomics and Bioinformatics, , John Wiley and Sons Inc.
6. S. Suhai, 2002, Genomics and Proteomics- Functional and Computational Aspects, , Plenum Publication.
7. Pennington & Dunn, 2000, Proteomics from Protein Sequence to Function, ,1 st edition, CRC Press, San Diego.

Web links:
http://nptel.ac.in/courses/102103017/

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BT-DS-525)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BT-DS-525.1	1	2	2	2	2	2	-	-	1	1	1	1	3	3	1	1
BT-DS-525.2	3	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2

BT-DS-525.3	3	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2
BT-DS-525.4	3	1	1	2	2	2	2	1	1	1	1	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BBT-DS-526: WASTE WATER TREATMENT

Periods/week	Credits		Max. Marks	:200
L: 3	T: 0	3	Continuous evaluation	: 100
Duration of Ext. Exam: 3 Hrs			End Semester Examination	:100

Course Outcomes:

The students will be able to-

BBT-DS-526.1 assimilate significant knowledge of different kinds of industrial wastes.

BBT-DS-526.2 evaluate physical, chemical and biological properties of waste.

BBT-DS-526.3assess different types of methods for waste treatment and disposal of solids.

BBT-DS-526.4apply different treatment and disposal methods for representative industries.

PART-A

Unit 1: Introduction to industrial waste

 1.1 Definition of waste and industrial waste.

 1.2 Principles of Industrial waste treatment.

 1.3 Waste disposal norms and regulations: International and Indian scenario.

Unit 2: Characteristics and composition of wastes

2.6 Sources of waste.

2.7 Types of industrial wastes: solid & liquid waste.

2.8 Composition of waste. Physical chemical, organic and biological properties of waste.

Unit 3: Waste reduction

 1.1 Alternatives for raw materials to reduce waste.

 1.2 Pretreatment of wastes; Collection of waste, segregation,

 1.3 Equalization. Reduction in volume and strength by other methods.

 1.4 Theories of neutralization and proportioning.

PART-B

Unit 4: Waste treatment I

4.1 Methods adopted for the removal of suspended colloidal and dissolved organic solids

4.2 Removal of inorganic dissolved solids - disposal of sludge solids

4.3 Physical and chemical Unit operations

4.4 Aerobic and anaerobic biological wastewater treatment system

4.5 Biological nutrient removal. Water reuse

Unit 5: Waste treatment II

 a. Treatment, reuse and disposal of solids and biosolids

 b. Biological methods for stabilization and disposal of solid wastes

 c. Treatment of hazardous wastes

 d. Degradation of xenobiotics

Unit 6: Customized waste

 1.1 Treatment and disposal methods of the Food Industries:

 1.2 Treatment and disposal methods of Fermentation Industries

 1.3 Treatment and disposal methods of Meat, and Dairy. Material Industries

 1.4 Treatment and disposal methods of Paper and petroleum refineries.

1.5 Miscellaneous Industries: Textile, Tanning, Fertilizers and Atomic energy plants

Text Books:
1. Metcalf and Eddy,Wastewater Engineering - Treatment and reuse, TataMcGraw– Hill Publication.
2. G. Tchobanoglous,Handbook of Solid Waste Management, McGraw-Hill Publication.
3. K.L.ShahBasics of Solid and Hazardous Waste Management Technology, Prentice Hall Publication.
4. S. E. Jorgensen, Industrial Waste Water Management, Elsevier Science Ltd Publication.
5. Salah M. El-Haggar,Sustainable Industrial Design and Waste Management: Cradle-to-Cradle for ustainable Development: Academic Press Publication.
6. B. Bilitewski, Waste Management, Springer Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BT-DS-526)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BT-DS-526.1	1	2	2	2	2	2	-	-	1	1	1	1	3	3	1	1
BT-DS-526.2	3	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2
BT-DS-526.3	3	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2
BT-DS-526.4	3	1	1	2	2	2	2	1	1	1	1	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-527: FOOD PROCESS TECHNOLOGY

Periods/week Credits		Max. Marks : 200
L: 3 T: 0 3		Continuous Assessment : 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcomes:
The students will be able to

BBT-DS-527.1   describe the concept and principle and need for the Food Processing
BBT-DS-527.2   distinguish the methods of preservation and processing used for different types of food.
BBT-DS-527.3   apply the scientific principles in processing and storage of food and improving product quality
BBT-DS-527.4   design appropriate method of processing and preservation of food using emerging technologies.

PART-A
Unit 1: Introduction
1.1 Definition, history and scope of food processing
1.2 General principles of food preservation
1.3 Different methods of food preservation: high temperature, low temperature, radiations, preservatives, canning, fermentation etc
1.4 Concepts of TDT, F, Z &D values.

Unit 2: Processing and storage of cereals
2.1 Control of infestation
2.2 Drying & milling of grains including, wheat, corn, barley, oat etc
2.3 Processed cereal products

Unit 3: Processing and storage of fruits and vegetables
3.1 Production and preservation of fruit and vegetable products
3.2 Juices
3.3 Jams
3.4 Jelly
3.5 Pickles
3.6 Marmalades

Unit 4: Processing and preservation of milk products and beverages
4.1 Fermented milk, curd, yogurt, Butter, Cheeses, cultured buttermilk
4.2 kefir, koumiss, Bulgarian milk, acidophilus milk
4.3 Non-alcoholic beverages

Unit 5: Processing and preservation of eggs and fish
5.1 Processing and preservation of poultry: Egg, egg products, chicken Handling,
5.2 Processing and preservation of fish and fish products (fish meal, fish concentrate, fish liver oil, sauce)
5.3 storage and transport of raw fish
5.4 Quality analysis of fish, eggs and chicken.

Units 6: Quality control of processed foods
6.1 GAP and GMP for Fruit and Vegetable production
6.2 Microbial safety of fresh and processed F&V
6.3 Quality control of packaged foods
6.4 Determination of shelf life

Text Books/ Reference Books
1. P. Fellows and H. Ellis, Food Processing Technology: Principles and Practice, New York.
2. P. Jelen, Introduction to Food Processing:., Prentice Hall Publication, Reston Virginia, USA.
3. Desrosier ,Technology of food Preservation:, Springer New York.
4. G.Jelling Sensory evaluation of Food-Theory and Quality control for fruits and vegetable products, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. M.J.Lewis,Physical Properties of Food and Food Processing Systems, Woodhead Publication, UK.
6. A.E. Bender, Food Processing and Nutrition, Academic Press Publication, London.

Web links
http://www.agrimoon.com/wp-content/uploads/FOOD-TECHNOLOGY.pdf

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-527.1	2	2	2	2	2	1	2	1	1	1	1	1	2	3	2	3
BBT-DS-527.2	2	1	2	1	1	1	1	-	-	-	1	-	2	3	2	1
BBT-DS-527.3	2	1	2	1	1	1	1	-	-	-	1	-	2	3	2	1
BBT-DS-527.4	2	1	2	1	1	1	1	-	-	-	1	-	2	3	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-528: ORGANIC AGRICULTURE

Periods/week	Credits	Max. Marks	: 200
L: 3	T: 03	Continuous Evaluation	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100	

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-
BBT-DS-528.1 interpret the scopes and opportunities of Organic Farming
BBT-DS-528.2Analyse the Need of Organic Farming in India
BBT-DS-528.3compare the different plant protection measures and discuss organic crop management in agriculture
BBT-DS-528.4 design an organic farming system

PART-A

Unit- 1: INTRODUCTION TO ORGANIC FARMING
1.1 Organic Farming: Introduction & Status
1.2 Detrimental effects of currently chemical dependant farming
1.3 Concepts & Principles of organic farming
1.4 Key indicators of organic farming
1.5 Components of organic farming
1.6 SWOT Analysis

Unit- 2: ORGANIC FARMING AND CLIMATE CHANGE
2.1 Sustainable Agriculture
2.2 Organic Farming & Climate Change
2.3 Principles of Compost Production
2.4 Vermicompost Production Technology
2.5 Enriched Vermicompost Production Technology
2.6 Vermicompost quality & marketing

Unit- 3: ORGANIC CROP MANAGEMENT
3.1 Introduction to organic crop management
3.2 Organic crop management- Cereals
3.3 Organic crop management- Pulses
3.4 Organic crop management- Oilseed Crops
3.5 Organic crop management- Horticulture crops-Vegetables & Fruits
3.6 Organic crop management- Horticulture crops-Medicinal Plants
3.7 Organic crop management- Plantation crops

PART-B

Unit- 4:PEST AND DISEASE MANAGEMENT

4.1 Plant protection measures
4.2 Biocontrol Agents
4.3 Biopesticides
4.4 Natural predators
4.5 Cultural practices
4.6 Trap & Cover crops
4.7 Weed management

Unit- 5: ORGANIC FARMING SYSTEM
5.1 Crop Planning in Organic Farming System
5.2 Rotation design for organic system
5.3 Integrated Plant Nutrient management
5.4 Transition to organic agriculture
5.5 Integrated Farming system
5.6 Urban Agriculture

Unit- 6: ORGANIC FOOD
6.1 Organic food and human health
6.2 Organic Meat Production
6.3 Quality analysis of organic foods
6.4 Antioxidants and their natural source
6.5 Standards of organic food
6.6 Organic certification Process
6.7 Marketing of Organic Products

Text Books/Reference Books
1.   P. Kristiansen, A.Taji and J. Reganold , 2006, Organic Agriculture, A Global Perspective, CSIRO PUBLISHING
2.   S. Chandran , M.R. Unni and Sabu Thomas, 2018, Organic Farming, 1st Edition,Global Perspectives and Methods, , Woodhead Publishing
3.   Training manual for Organic Agriculture, Edited by Nadia SCIALABBA, Compiled by Ilka GOMEZ and Lisa THIVANT, 2015, FAO
4.   **D, Nandwani**, 2016,Organic Farming for Sustainable Agriculture, (Ed.), Springer

Software required/Weblinks:
http://www.hillagric.ac.in/edu/coa/agronomy/lect/agron-3610/Lecture-1-Introducing-Organic-Agriculture.pdf
https://www.coabnau.in/uploads/1587019407_Principlesoforganicfarming.pdf
Web links:

Instruction for paper setting: Seven questions are to be set in total.   First question will be conceptual covering entire syllabus and will be compulsory to attempt.   Three questions will be set from each PART-A and PART-B (one from each Unit).   Student needs to attempt two questions out of three from each part.   Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%

Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-528)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-528.1	-	2	-	-	-	-	1	-	-	-	-	-	3	2	2	1
BBT-DS-528.2	2	2	1	-	1	1	3	1	-	1	-	2	2	1	2	1
BBT-DS-528.3	2	2	1	1	1	-	-	-	-	-	2	1	2	2	3	1
BBT-DS-528.4	3	-	3	3	3	2	2	2	3	3	3	3	3	3	3	2

6thSEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-601: PLANT BIOTECHNOLOGY

Periods/week   Credits   Max. Marks   : 200
L: 3   T:0   3   Continuous Evaluation   : 100
Duration of Ext. Exam: 3 Hrs   End Semester Examination: 100

Pre-requisites:knowledge of basic 10+2 science
Course Type: Core

Course Outcomes:
The students will be able to
BBT-DS-601.1   describe and select various plant tissue culture techniques for appropriate use.
BBT-DS-601.2   illustrate the molecular mechanisms inherent in plant biotechnology.
BBT-DS-601.3   apply different techniques for growth promotion of cultured tissues/plant.
BBT-DS-601.4   hypothesize the strategy for improvement of plants through biotechnological approaches.

PART-A
Unit 1: Introduction
1.1 Basic of tissue culture
1.2 Cellular totipotency
1.3 Cytogenetic &organogenic differentiation
1.4 Plant Tissue Culture techniques: Basic concepts
1.5 Seed, Embryo, Callus, Organ, Cell and Protoplast culture
1.6 Micropropagation
1.7 *In Vitro* Haploid Production: Androgenic haploid, Gynogenic haploids

Unit 2: Protoplast Isolation and Fusion
2.1 Protoplast isolation
2.2 Protoplast fusion
2.3 Identification and selection of hybrid cells
2.4 Somatic hybridization
2.5 Cybridization
2.6 Somaclonal&Gametoclonal Variation

Unit 3: Growth Promotion by Bacteria
3.1 Nitrogen fixation by bacteria
3.2 Symbiosis and antibiosis
3.3 Process of Nodulation
3.4 Biocontrol of pathogens
3.5 Plant growth promoting bacteria
3.6 Production of pathogen free plants.

PART-B
Unit 4: Genomics and Proteomics
4.1 Mapping of prokaryotic genome
4.2 Mapping of eukaryotic genome
4.3 Construction of linkage maps with molecular markers
4.4 Screening of libraries
4.5 Sequencing
4.6 Proteomics

Unit 5: Plant Molecular Biology

5.1 Transient and stable gene expression
5.2 Marker genes
5.3 Chimeric gene vectors
5.4 Gene transfer in plants -Vector mediated gene transfer
5.5 Gene transfer in plants - Vectorless or direct DNA transfer

Unit 6: Transgenics in Crop Improvement

6.1 Resistance to biotic stresses
6.2 Insect resistance
6.3 Virus resistance
6.4 Disease resistance
6.5 Resistance to abiotic stresses
6.6 Herbicide resistance
6.7 Transgenics for quality improvement

Text Books/ Reference Books

1. S.S. Bhojwani and M.K. Razdan, 2010, Plant Tissue culture: Theory and Practice, Elsevier Science Publication, Netherlands.
2. B.R. Glick, J.J. Pasternak, 2010, Molecular Biotechnology: Principles and Applications of recombinant DNA, ASM press Publication, Washington DC.
3. P.K. Jaiwal, R.P. Singh, 2009, Plant Genetic Engineering, Metabolic engineering and Molecular farming, Studium Press LLC Publication, U.S.A.

Web links:

https://www.ncbi.nlm.nih.gov › NCBI › Literature › PubMed Central (PMC)
https://www.ncbi.nlm.nih.gov/pubmed/965014
vle.du.ac.in/mod/book/view.php?id=13141&chapterid=28369

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-601)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4

BBT-DS-601.1	2	-	2	2	2	-	-	-	1	-	-	2	3	3	2	-
BBT-DS-601.2	2	2	2	3	2	2	2	-	2	1	3	3	2	2	1	1
BBT-DS-601.3	2	1	-	2	2	-	-	-	2	1	2	1	-	1	1	-
BBT-DS-601.4	2	-	2	2	2	2	2	-	2	1	-	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-602: ENVIRONMENTAL BIOTECHNOLOGY

Periods/week Credits	Max. Marks : 200
L: 3 T:0 3	Continuous Evaluation : 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination: 100

Pre-requisites:knowledge of basic 10+2 science
Course Type: Core

Course Outcomes:
The students will be able to-
  BBT-DS-602.1 assimilate significant knowledge of environmental resources and global environmental issues.
  BBT-DS-602.2 differentiate among various technologies of bioremediation.
  BBT-DS-602.3 evaluate the use of microorganisms and their processes to improve environmental quality.
  BBT-DS-602.4 design ecofriendly technologies for human society.

PART-A
Unit 1: Environmental Resources
 1.1 Environmentalperturbation: air pollution
 1.2 Environmentalperturbation: water pollution
 1.3 Environmentalperturbation: soil pollution
 1.4 Global Environmental issues: Greenhouse effect, Ozone depletion, Acid rain, UV radiation

Unit 2: Waste Water Treatment
 2.1 Waste water: Definition, types and collection
 2.2 Waste water treatment: physical and chemical processes
 2.3 Waste water treatment: biological processes-Aerobic and Anaerobic processes
 2.4 Treatment technologies for removal of Oil and Heavy Metals

Unit 3: Hazardous Wastes
 3.1 Definition, Classification and Characteristics
 3.2 Industrial and hospital waste
 3.3 Management and landfill
 3.4 Composting: Introduction and types, Material and process, Physiochemical characteristics, decomposition stages and systems

PART-B
Unit 4: Biodegradation
 4.1 Definition of Biodegradation, Factors affecting process of biodegradation, Methods in determining biodegradability
 4.2 Contaminant availability for biodegradation
 4.3 Xenobiotics: Introduction, Persistence and biomagnification of xenobiotic molecules, Microbial interactions with xenobiotics
 4.4 Use of microbes (bacteria and fungi) and plants in biodegradation and Biotransformation

Unit 5: Bioremediation
 5.1 Introduction, Systems, technologies: In situ and ex situ technologies

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5.2 Factors influencing bioremediation
5.3 Role of microbes: bacteria, algae and fungi, constraints and priorities
5.4 Phytoremediation and applications.

Unit 6: Ecofriendly Technologies
6.1 Vermicomposting, Biomining, Biofuel, Bioplastics
6.2 Biotechnology for management of Environmental Resources
6.3 Biomass and Biogas production
6.4 Cleaner Technologies and sustainable development.

Text Books/ Reference Books:
1. Martin Alexander, 1999, Biodegradation & Bioremediation, Academic Press Publication.
2. Alan Scragg, 1995, Environmental Biotechnology, Oxford University Press.
3. Bruce Rittman, P.L. McCarty, 2012, Environmental Biotechnology-Principles and Applications, McGraw-Hill Publication.
4. R.M. Maier, I.L. Pepper, C.P. Gerba, 2002, Environmental Microbiology, Academic Press Publication.

Web links:
http://nptel.ac.in/courses/105105048/
http://nptel.ac.in/courses/122106030/Pdfs/1_4.pdf
http://nptel.ac.in/courses/105104102/4
http://nptel.ac.in/courses/102103013/module7/lec4/5.html
http://nptel.ac.in/courses/105108075/module9/Lecture40.pdf

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-602)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-602.1	2	3	2	2	3	-	-	1	-	-	2	2	3	2	3	2
BBT-DS-602.2	3	2	1	1	2	-	-	-	-	-	2	3	3	3	2	-
BBT-DS-602.3	2	3	1	2	2	1	-	-	2	1	2	1	2	2	1	-
BBT-DS-602.4	3	3	1	2	2	1	1	-	2	1	3	2	2	2	1	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-651: CELL & TISSUE CULTURE LAB

Periods/week Credits	Max. Marks :100
P: 3 T: 0 1.5	Continuous Evaluation : 50
Duration of Ext. Exam: 3 Hrs	End Semester Examination: 50

Pre-requisites:knowledge of basic 10+2 science
Course Type: Core

Course outcomes:
The students will be able to-
BBT-DS-651.1 learn the sterilization techniques and preparation of nutrient media for tissue culture.
BBT-DS-651.2develop plant tissue cultures from various explants and also learns protoplast isolationby enzymatic method.
BBT-DS-651.3demonstrate and apply the basic techniques of animal tissue culture.
BBT-DS-651.4apply the cytotoxicity assay method.

List of Experiments:

1. To study different sterilization techniques.
2. To prepare Hoagland medium for tissue culture.
3. To prepare Murashig&Skoog's (MS) medium for tissue culture.
4. To study different growth parameters in plants.
5. To study embryo culture from *Triticumaestivum*.
6. To culture the anther to get whole plant.
7. To isolate the plant protoplast by enzymatic method.
8. To isolate the DNA from cultured cell/plantlet or plant tissue.
9. To study *Agrobacterium* mediated gene transfer method in plants.
10. To prepare Minimal Essential Medium for animal cell culture.
11. To learn the techniques of sub culture of adherent cell lines
12. To carry out sub culture of suspended cell lines.
13. To carry out cryopreservation of cells.
14. To perform cell quantification.
15. To carry out cytotoxicity assay.

Reference Books:
1. J.H. Dodde and L.W. Roberts, 1998, Experiments in plant tissue culture, Cambridge University Press Publication.
2. R.J. Henry, 2015, Practical application of Plant Molecular biology, Chapman and Hall Publication.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-651)	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O 2	PS O 3	PSO 4
BBT-DS-651.1	3	3	2	2	-	2	3	1	1	2	1	1	1	3	2	-
BBT-DS-651.2	3	3	1	-	-	2	3	1	1	2	1	1	1	2	2	-
BBT-DS-651.3	3	3	1	2	-	2	3	1	1	2	1	1	1	3	2	1
BBT-DS-651.4	3	3	-	-	-	2	3	1	1	2	1	1	-	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-652A: ENVIRONMENT BIOTECHNOLOGY LAB

Periods/week	Credits	Max. Marks	:100
P: 3 T: 0	1.5	Continuous Evaluation : 50	
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 50	

Pre-requisites: knowledge of basic 10+2 science
Course Type: Core

Course outcomes:
The students will be able to
BBT-DS-652A.1 estimate of physical, chemical and biological parameters of water.
BBT-DS-652A.2 determine the different solid contents in wastewater.
BBT-DS-652A.3 determine alkalinity, hardness and electrical conductivity of water samples.
BBT-DS-652A.4 determine the chemical oxygen demand of water.

List of Experiments:

1. To determine the physical parameters of water.
2. Estimation of pH and EC in given water samples.
3. Estimation of TDS, hardness and alkalinity in given water samples.
4. Estimation of Chloride and Salinity in given water samples.
5. Estimation of Nitrate in given water samples.
6. Estimation of Flouride and ammonia in given water samples.
7. Isolation, Identification, characterization of microbes collected from nearby polluted area/ industries and study of their enzymes
8. To determine BOD value for determining biodegradability of solution
9. To determine COD value for determining organic strength of solution
10. Microbial degradation of textile dyes/pesticides/hydrocarbons and oils
11. Estimation of Heavy metals in soil/ water samples.
12. To estimate suspended particulate matter and gases in ambient air.
13. Identification and screening of Hyperaccumulator plant species for Heavy Metals.
14. To study the production of Vermicompost.
15. Field Trip : Wastewater Treatment Plant

Reference Books:
1. Alan Scragg, 1995, Environmental Biotechnology, Oxford University Press.
2. Bruce Rittman, Perry L. McCarty, 2012, Environmental Biotechnology-Principles and Applications, McGraw-Hill Publication.
3. Raina M. Maier, Ian L. Pepper, Charles P. Gerba, 2002, Environmental Microbiology, Academic Press Publication.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-652A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-652A.1	3	3	2	2	-	2	3	1	1	2	1	1	1	3	2	-
BBT-DS-652A.2	3	3	1	-	-	2	3	1	1	2	1	1	1	2	2	-
BBT-DS-652A.3	3	3	1	2	-	2	3	1	1	2	1	1	1	3	2	1
BBT-DS-652A.4	3	3	-	-	-	2	3	1	1	2	1	1	-	2	2	1
BBT-DS-652A.5	3	3	1	-	-	2	3	1	1	1	1	1	-	-	1	-
BBT-DS-652A.6	3	3	-	-	-	2	3	1	1	2	1	1	-	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

PROJ-BT-600A: MINOR PROJECT

Periods/week   Credits   Max. Marks   : 50
P:2   1   Continuous Evaluation   : 50
Duration of Exam: 2 Hrs

Pre-requisites: None
Course Type: Project

Course outcomes:
The students will be able to-
PROJ-BT-600A.1 survey relevant research literature and learn to communicate effectively.
PROJ-BT-600A.2 assimilate the purpose of research through literature survey.
PROJ-BT-600A.3 acquire ability to identify the gaps in research and hypothesize the solutions to real life problems.
PROJ-BT-600A.4 appraise the importance of ethics in research.

Every student will have to undertake a research project in the field relevant to Biotechnology. Each student will be allocated a faculty supervisor depending upon the area of his/ her interest. In further course of time the student will identify the research problem and do the literature survey. In Minor Project Phase-I every student is expected to at least build the hypothesis, set the objectives and decide upon the work-plan for the research to be carried out in Minor Project Phase-II. During this course of time he/she will be regularly monitored and evaluated by the Project Supervisor and the Departmental Project Committee. Continuous monitoring will include Seminar Presentations and Feedback from supervisor. At the end of the Minor Project Phase-I, each student will have to submit a Synopsis (soft bound), deliver a presentation pertaining to the research work and will have to appear for viva during Continuous evaluation Examination.

Continuous Evaluation:
Continuous Performance   - 15 Marks
Literature Review   - 10 Marks
PPT & Report   - 20 Marks
Attendance   - 05 Marks

Course Articulation Matrix

Minor Project Phase I (PROJ-BT-600A)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
PROJ-BT-600A.1	3	3	2	3	3	2	3	2	1	2	1	3	3	3	3	3
PROJ-BT-600A.2	1	3	2	3	2	1	3	2	1	2	1	3	3	3	3	3
PROJ-BT-600A.3	1	1	1	1	1	1	2	3	1	1	2	3	1	1	3	3
PROJ-BT-600A.4	3	3	2	3	3	2	3	2	2	2	3	3	3	3	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BHM-MC-009: Quantitative Aptitude & Personality Development III

Periods/week	Credits	Max. Marks	: 100
P:2 T:0	AP	Continuous Evaluation	: 50
Duration of Exam: 2hrs		End Semester Examination(Written)	: 50

Pre-requisites: None
Course Type: HSMC
Course Outcomes
The students will be able to-
BHM-MC-009.1 recognize problem based on Modern Mathematics and Algebra
BHM-MC-009.2 solve basic to moderate level problems based on Mensuration and Geometry.
BHM-MC-009.3 calculate solution to logical reasoning.
BHM-MC-009.4 gainproficiency with resume building and will be able to draft effective cover letters.
BHM-MC-009.5 participate effectively and confidently in a Group Discussions.
BHM-MC-009.6 manage interviews effectively.

PART – A
Unit 1: Modern Mathematics and Algebra
1.1 Permutation and Combination
       1.1.1 Principal of counting and Basic formulas
       1.1.2 Arrangements, Selection and Selection + Arrangement.
       1.1.3 Linear/Circular arrangements, Digits and Alphabetic Problems and Applications.
1.2 Probability
       1.2.1 Events and Sample Space, Basic Formulas.
       1.2.2 Problems on Coins, Cards and Dices.
       1.2.3 Conditional Probability, Bayes' Theorem and their Applications.
1.3 Algebra
       1.3.1 Linear & Quadratic equations
       1.3.2 Mathematical inequalities
       1.3.4 Maximum & Minimum Values
       1.3.3 Integral Solutions

Unit 2: Geometry and Mensuration
2.1 Geometry
       2.1.1 Basic geometry & Theorems, Lines & Angles
       2.1.2 Polygons, Triangle and Quadrilaterals
       2.1.3 Circles
2.2 Mensuration I- Areas
       2.2.1 Different types of Triangles and their area and perimeter.
       2.2.2 Different types of Quadrilateral and their area and perimeter.
       2.2.3 Circumference and Area of Circle, Area of Sector and length of Sector.
       2.2.4 Mixed Figures and their Applications.
2.3 Mensuration II- Surface Areas and Volumes
       2.3.1 Problems on Cubes & Cuboids, Cone, Cylinder and Sphere.
       2.3.2 Prism and Pyramid.
       2.3.3 Mixed Figures and their Applications.
Unit 3: Logical Reasoning

3.1 Linear Arrangement
3.2 Circular Arrangement
3.3 Puzzles

Part - B

Unit 4: Professional Writing
    4.1. Profiling on Social Sites: LinkedIn, Facebook, Instagram
    4.2. Cover Letter/Emails
    4.3. Resume Writing

Unit 5: Group Discussions
    5.1. Do's and Dont's of a Group Discussion
    5.2. Roles played in a Group Discussion
    5.3. Tips for Cracking a Group Discussion

Unit 6: Managing Interviews
    6.1. Developing the employability mindset
    6.2. Preparing for Self -Introduction
    6.3. Researching the employer
    6.4. Portfolio Management
    6.5. Answering Questions in an Interview

Text Books/Reference Books:
1. R S Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations: S Chand & Company Pvt Ltd.
2. R S Aggarwal, 2018, A Modern Approach to Verbal& Non Verbal Reasoning, S Chand & Company Pvt. Ltd.
3. P.A. Anand, 2017, Verbal Ability and Reasoning for Competitive Examinations, Wiley

Instructions for paper setting: Fifty MCQ will be set in total. Twenty five MCQ will be set from Part A and twenty five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Continuous Evaluation:
Sessional   - 30 Marks
Assignments   - 10 Marks
Class Work/Performance - 05 Marks
Attendance   - 05 Marks

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO (BHM-MC-009)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BHM-MC-009.1	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-
BHM-MC-009.2	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-
BHM-MC-009.3	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-
BHM-MC-009.4	-	-	-	-	-	-	-	1	-	3	-	1	-	-	-
BHM-MC-009.5	-	-	-	-	-	-	-	1	-	3	-	-	-	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

HM-606 : French-2

Periods/week Credits	Max. Marks : 100
L: 2 T: 0 2.0	Continuous Evaluation : 50
Duration of Examination: 1.5 Hrs	End Sem Examination : 50

Pre-Requisites: Basic knowledge of grammatical structure, syntax, and vocabulary of French
Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-
HM-606.1. Exchange greetings and do introductions using formal and informal expressions. Understand and use interrogative and answer simple questions.
HM-606.2. Learn basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed.
HM-606.3. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.
HM-606.4. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary. Provide basic information about familiar situations and topics of interest.
HM-606.5. Express or/and justify opinions using equivalents of different verbs. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture.
HM-606.6. Describe various places, location, themselves using simple sentences and vocabulary.

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PART – A
</div>

Unit 1- Se présenter (1)
1.1 Les pluriels
1.2 Adjectives to describe a person

Unit 2- Se présenter (2)
2.1 Professions
2.2 Short essay on family & friend
2.3 Comprehension

Unit 3- Parler de ses habitudes quotidiennes
3.1 Les verbes pronominaux
3.2 Décrivez votre journée

<div align="center">

PART – B
</div>

Unit 4- Nommez et localiser des lieux dans la ville
4.1 Prepositions
4.2Asking & telling the way

Unit 5- Informations simples sur le climat, la météo
5.1 Les saisons
5.2 Les expressions de la saison

5.3 Comprehension

Unit 6- Demander/ indiquer les horaires et les couleurs
6.1 Timings
6.2 Colours

Text Books/Reference Books/ Suggested Readings:
1. Annie Berthet, Catherine Hugot, Veronique M Kizirian,2006, Alter Ego Level One Textbook, Hachette Publications.
2. Mahitha Ranjit, 2016, Apprenons Le Francais II & III, Saraswati Publications.

Weblinks:
www.bonjourfrance.com
www.allabout.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM–606)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HM-606.1	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-606.2	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-606.3	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-606.4	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-606.5	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-606.6	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

HM-607: GERMAN – 2

Periods/week Credits	Max. Marks : 100
L: 2 T: 0 2.0	Continuous Evaluation : 50
Duration of Examination: 1.5 Hrs	End Sem Examination : 50

Pre-Requisites: Students are expected to have basic knowledge of German grammar. They should know regular verbs and conjugations. They should be able introduce themselves and make small sentences in German language.
Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-
   HM-607.1. Discuss about various directions, countries and languages they speak.
   HM-607.2. Write short essays on family and friends. They will have knowledge of tenses.
   HM-607.3. Identify classroom vocabulary in the German language.
   HM-607.4. Speak ordinal and cardinal numbers and they will also learn months, days in German.
   HM-607.5. Express or/and justify opinions using equivalents of different verbs.
   HM-607.6. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.

PART – A
Unit 1: Ordinal und Kardinal Zahlen,
1.1 Ordinal & Cardinal numbers
1.2 Months, days, Feiertage and dates

Unit 2: sein und haben
2.1 Verbs: to be and to have
2.2 helping verbs practice worksheets
2.3 Vocabulary (Family) short essay on family, friends etc.

PART – B
Unit 3: Gegenstände im Kursraum
3.1 Vocabulary (classroom)
3.2 Definite and indefinite articles

Unit 4: Länder, Sprachen
4.1 Countries, languages, directions
4.2 Past of the verb 'to be'

Text Books/Reference Books:
1. Rita Maria Niemann,Cornelsen, 2005, Studio d A1: Deutsch alsFremdsprache, Volume 6.
2. Dallapiazza, Rosa-Maria and Jan, Eduard von. Tangram aktuell 1. Deutsch alsFremdsprache Tangram aktuell 1 - Lektion 1-4: Deutsch als. (HueberVerlag, 2005).
3. Dallapiazza, Rosa-Maria and Jan, Eduard von. Tangram aktuell 1. Deutsch alsFremdsprache Tangram aktuell 1 - Lektion 5-8: Deutsch als. (HueberVerlag, 2005).
4. Paul Rusch, 2015: Langenscheidt and Klett.

Weblinks:
http://www.nthuleen.com/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM–607)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HM-607.1	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-607.2	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-607.3	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-607.4	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-607.5	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-607.6	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1

HM-608: SPANISH – 2

Periods/week Credits	Max. Marks : 100
L: 2 T: 0 2.0	Continuous Evaluation : 50
Duration of Examination: 1.5 Hrs	End Sem Examination : 50

Pre-Requisites: Students are expected to have basic knowledge of Spanish Grammar. They should be able to understand Spanish language along with basic skills for communication. Students are also expected to have basic knowledge of Spanish Culture.
Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-
HM-608.1. Know about various color names in Spanish along with various vocabularies related to cloths and wardrobe.
HM-608.2. Differentiate between Ser and Estar verbs along with uses.
HM-608.3. Understand adjectives along with telling time.
HM-608.4. Learn Count till 1000
HM-608.5. Acquire knowledge of regular –ER and –IR verbs along with its various uses.
HM-608.6. Assess knowledge of vocabulary related to family and marital status.

PART – A
Unit 1 : Color and Clothing
1.1 Introduction of colors
1.2 Vocabulary related to clothes and wardrobe

Unit 2 : Ser, Estar and Haber
2.1 Difference between the use of Verbo SER and ESTAR and their use with the similar adjective.
2.2 Introduction of Verbo HABER

PART – B
Unit 3 : Adjective, Counting and Time
3.1 Demonstrative adjectives
3.2 Counting till 1000
3.3 Time

Unit 4 : Verb ER and IR and Family
4.1 Introduction and Usage of –ER Verbs
4.2 Introduction and Usage of –IR Verbs
4.3 Vocabulary related to the family and marital status

Text Books/Reference Books:
1. Eric V Greenfield, 1971, Barnes and Noble.
2. Nuevo Espanol sin fronteras, Jesus Sanchez Lobato and Isabel Santos Gargallo, 2005, Goyal Saab, ELE & SGEL.

Weblinks:
http://studyspanish.com/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from

the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM-608)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HM-608.1	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-608.2	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-608.3	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-608.4	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-608.5	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-608.6	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BBT-DS-624: DRUG DELIVERY SYSTEMS

Periods/week   Credits   Max. Marks   : 200
L: 3   T: 0   3   Continuous Evaluation   : 100
Duration of Ext. Exam: 3 Hrs   End Semester Examination: 100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcomes:
The students will be able to
BBT-DS-624.1   describe the basics of controlled drug delivery systems.
BBT-DS-624.2   interpret the different laws governing the release of drugs from controlled release drug delivery systems.
BBT-DS-624.3   illustrate the kinetics of controlled drug delivery systems.
BBT-DS-624.4   explain different types of drug delivery systems such as nano, dermal, mucoadhesive, etc drug delivery systems.

PART-A

Unit 1: Introduction to drug delivery systems
1.1. What is a drug delivery system?
1.2 Different dosage forms for drug delivery systems
1.3 Regulations and pharmacopeial directives, consideration in developing drugs and delivery systems
1.4. Routes of administration of drug delivery systems

Unit 2: Controlled delivery systems
2.1. Introduction and definitions of controlled delivery systems
2.2 Factors to be considered for designing controlled release dosage forms (CRDF)
2.3 Dissolution, Diffusion, Combination of dissolution and diffusion controlled drug delivery systems.
2.4. Evaluation of CRDF.

Unit 3: Fundamentals of Controlled Release (CR) Drug Delivery
3.1. Rationale of sustained/controlled drug delivery
3.2. Theory of mass transfer
3.3. Fick's first and second laws and their applications in drug release and permeation.

PART-B

Unit 4: Pharmacokinetic/pharmacodynamics of controlled drug delivery
4.1. Kinetics of delayed release
4.2. Kinetics of sustained and controlled release
4.3. Pharmacopeial tests
4.4. Reservoir systems, zero order, rate limiting membrane, first order
4.5. Demonstrations of tablets and capsules, osmotic delivery, demonstrations.

Unit 5: Matrix delivery systems
5.1. Higuchi's equations
5.2. Demonstration of tablets and capsules
5.3. Hydrophilic matrices

5.4. Degradable matrices and their demonstrations.

Unit 6: Different delivery systems
6.1. Muco adhesive drug delivery systems
6.2. Transdermal drug delivery systems
6.3. Parenteral controlled release drug delivery systems
6.4. Nano drug delivery systems
6.5. Targeted drug delivery

Text Books/Reference Books:
1. Y.W.Chien,1992, Novel drug delivery systems, 2nd edition, revised and expanded, Marcel Decker, Inc., New York
2. J.R.Robinson ,V.H.L.Lee, 1992,Controlled drug delivery systems, Marcel Decker, Inc., New York.
3. Howard C. Ansel, Nicholas G. Popovich, Loyd V. Allen. Pharmaceutical dosage forms & drug delivery systems. Waverly pvt, Ltd, New Delhi, Sixth edition
4. N.K.Jain,1997 (reprint in 2001) Controlled and novel drug delivery, CBS Publishers & Distributors, New delhi,First edition
5   S.P.Vyas and R.K.Khar,2002, Controlled drug delivery-concepts and advances, VallabhPrakashan, New Delhi, first edition.
6.Indian Pharmacopoeia 2010. Volume -I, II & III, Indian Pharmacopoeia Commission. New Delhi.

Web links:
http://nptel.ac.in/courses/118106019/Module%209/Lecture%201/Lecture%201.pdf

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-624)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BBT-DS-624.1	2	2	3	2	2	2	2	2	1	1	1	2	2	2	2	3
BBT-DS-624.2	3	2	2	2	1	1	1	1	2	2	1	3	2	2	2	1
BBT-DS-624.3	2	2	3	2	2	1	1	2	2	1	2	2	2	2	2	1
BBT-DS-624.4	2	2	2	2	1	2	2	2	2	2	2	1	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-625: MOLECULAR DIAGNOSTICS

Periods/week Credits	Max. Marks :200
L: 3 T: 0 3	Continuous Evaluation :100
Duration of Ext. Exam: 3 Hrs	End Semester Examination:100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcomes
The students will be able to-
BBT-DS-625.1 describe basic and important aspect of molecular diagnostics fundamentals.
BBT-DS-625.2 indicate various causes and categorize different classes of diseases at molecular level.
BBT-DS-625.3 evaluate different types of molecular tools needed for identification of a disease.
BBT-DS-625.4predict the right diagnostic technique for detecting a disorder/disease.

PART-A

Unit1:   Introduction and History of diagnostics
1.1 History of diagnostics
1.2 Significance, Scope, Rise of diagnostic industry in Indian and global scenario
1.3 Philosophy and general approach to clinical specimens
1.4 Sample analysis: method of collection, transport, processing of samples and Interpretation of results
1.4 Normal microbial flora of the human body
1.5 Host - Parasite relationships

Unit2: Molecular & Genetic Basis of Disease
2.1 Genomic Instability
2.2 Mutations: Types
2.3 Mutation; Mechanism
2.4 Mutation Pathology
2.5 Detection of Mutation

Unit3: Tools for Molecular Diagnostics
3.1 Restriction Endonucleases; DNA Cloning
3.2 DNA Amplification; Polymerase Chain Reaction
3.3 Nucleic Acid Hybridizations: Principles and Application
3.4 DNA Sequencing
3.5 Genotyping

PART-B

Unit-4: Molecular diagnosis of Diseases
4.1 Significance in prenatal disease diagnosis
4.2 Detection of Disease: Single strand conformation analysis, Heteroduplex analysis, Denaturing
4.3 Gradient Gel Electrophoresis, Chemical mismatch cleavage, Direct DNA Sequencing
4.4 Molecular Diagnostic for Hepatitis, Rabies, Herpes and Tuberculosis
4.5 Diagnosis of genetic diseases and metabolic disorders
4.6 Nucleic acid amplification methods and types of PCR
4.7 Hybridization techniques and DNA sequencing methods in molecular diagnosis

Unit-5: Immunodiagnostics

5.1 Antigen-Antibody Reactions,

5.2 Conjugation Techniques,

5.3 Cell based diagnostics: Antibody markers, CD Markers, FACS, HLA typing,

5.4 Immunoassay Systems: Enzyme-Linked Immunosorbent Assay (ELISA), Luminescent immunoassay (LIA), and fluorescent immunoassay (FIA)

5.5Radioimmunoassay (RIA),

Unit 6: Molecular Diagnostic Applications

6.1 Genetic Testing: Principles and Practice

6.2 Applications of DNA Testing

6.3 DNA Testing Methodology

6.4 Diagnosis of Inherited Diseases-I

6.5 Diagnosis of Inherited Diseases-II

6.6 Diagnosis of Pathological Conditions

Web links:

www.springer.com/adis/journal/40291

https://www.imperial.ac.uk/medicine/study/e-learning/

Text Books/Reference Books

1. R. A. Goldsby, T.J. Kindt, B.A. Osborne, 2011, Kuby- Immunology, W H Freeman & Co Publication.
2. W.E. Paul, 2006, Fundamentals of Immunology, Raven Press Publication, New York.
3. Bailey and Scott, St. Louis , 2017, Diagnostic Microbiology, Missouri : Elsevier.
4. Ritter, 1995, Monocional Antibodies, Cambridge University Press Publication, New York.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-625.1	3	3	2	-	1	2	2	1	1	1	-	2	3	3	2	-
BBT-DS-625.2	3	3	2	3	2	2	2	1	2	1	3	3	2	2	1	-
BBT-DS-625.3	3	1	-	2	2	-	-	1	2	1	2	1	2	1	1	1

BBT-DS-625.4	3	3	2	2	2	2	2	1	2	2	-	2	2	2	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-626: BIOREMEDIATION & BIOFUELS

Periods/week   Credits

L: 3   T: 0   3

Duration of Ext. Exam: 3 Hrs

Max. Marks   : 200

Continuous Evaluation   : 100

End Semester Examination: 100

Pre-requisites:knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcome:

The students will be able to

BBT-DS-626.1 understand the basic concepts of various techniques involved in the removal of various toxic chemicals present in soil and water

BBT-DS-626.2 understand the mechanisms employed by microorgamisms and plants to carry out bioremediation

BBT-DS-626.3 distinguish between the different generation bioenergy production in terms of operating conditions, useful products and by-products

BBT-DS-626.4 design strategies to solveproblems relating to the production and use of different forms of biomass energy

PART-A

Unit 1: Introduction

1.1 Pollutants in the soil and water

1.2 Physicochemical techniques for the removal for toxic substances from water and soil,

1.3 Bioremediation approaches for the removal of toxic chemicals

Unit 2: Bioiremediation of Heavy metals, Pharmaceutics and Xenobiotics

2.1 Occurance,

2.2 Degradation,

2.3 Bioremediation approaches,

2.4 Genetic engineering to enhance bioremediation

Unit 3: Bioremediation of Hydrocarbons, their Derivatives, and Polychlorinated Biphenyls

3.1 Occurance

3.2 Degradation

3.3 Bioremediation approaches

3.4 Limitations,

3.5 Genetic engineering to enhance bioremediation

3.6 Case studies

PART-B

Unit 4: Energy from Biomass

 4.1   Biomass for first generation bioenergy production in terms of their potential for production;

 4.2   land use; competition with food and other industrial crops;

 4.3   energy inputs in production; and transport logistics e.g. Sugar crops, Grains, Oilseeds

4.4 Biomass for second generation bioenergy production in terms of their production, composition, purity, conversion potential and environmental impacts e.g. Forestry and agricultural residues, Dedicated plantation,

4.5 Secondary biomass feedstocks (agricultural, industrial, commercial, and municipal organic wastes)

4.6 Biomass for third generation bioenergy production in terms of development of new biomass feedstocks and technical constrains e.g. micro and macro algae

Unit 5: Energy conservation and management

5.1 An economic concept of energy,

5.2 principles of energy conservation, approaches and technologies,

5.3 co- generation, waste heat utilization, energy storages,

5.4 energy fact file and policy in India and energy planning,

5.5 sustainable energy for clean environment.

Unit 6: Biofuels

6.1 Global fuel consumption, Alternative fuel options, Product comparisons, Producers, Agriculture & Biofuels

6.2 Cellulose Ethanol: Cellulose chemistry, Cellulose ethanol process, Cellulose pretreatment, Biomass feedstock Biomass Feed stocks (derived from food sources): Corn Stover, Soy residue, Wheat, Rice residue, Barley, Bagasse Biomass Feed stocks (not derived from food sources):

6.3 Switch grass, Miscanthus, Poplar, wood, Logging residue, tall fescue, Municipal solid waste,

6.4 Biodiesel: Biodiesel chemistry, Commercial Biodiesel Production, Biodiesel EmissionsCase Study: Piedmont Biofuels, Alternative liquid fuels.

Text Books/Reference Books:

1. Chandra, Ram, 2015, Advances in biodegradation and bioremediation of industrial waste. CRC Press.
2. Singh, Ajay, and Owen P. Ward, 2004, Applied bioremediation and phytoremediation, Springer Science & Business Media.
3. King, Barry, John K. Sheldon and Gilbert, 1997, Practical environmental bioremediation: the field guide, CRC Press.
4. R. C. Brown,2003,Biorenewable Resources: Engineering New Products from Agriculture.. Wiley-Black well Publishing.
5. Sunggyu Lee and Y.T. Shah,2012,Biofuels and Bioenergy: Processes and Technologies, ,CRC Press.

Web links:

http://nptel.ac.in/courses/126104003/

http://nptel.ac.in/courses/126104001/

http://nptel.ac.in/courses/102104057/3

https://www.princeton.edu/cefrc/Files/2012%20Lecture%20Notes/Green/Alternative-Fuels-Summer-School-2012-rev.pdf

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-626.1	2	2	2	2	2	2	-	-	1	1	1	1	3	3	1	1
BBT-DS-626.2	2	2	2	2	2	2	-	-	1	1	1	1	3	3	1	1
BBT-DS-626.3	3	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2
BBT-DS-626.4	3	2	2	2	-	1	1	-	1	1	2	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-627FOOD BIOPACKAGING

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3	Continuous Evaluation : 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination: 100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcomes:

The students will be able to-
BBT-DS-627.1 identify and explain the presence and detection of various microbes associated with food nutrients in foods and the specific functions in maintaining health.
BBT-DS-627.2 describe techniques that can be used to monitor quality of raw ingredients and final products.
BBT-DS-627.3 apply principles from the various facets of food biotechnology to solve practical, real-world problems such as the effects of common food preservation and production methods, and food storage conditions, on survival and growth of microbial contaminants.
BBT-DS-627.4 assess the utilization of food waste for production of valuables.

PART-A
Unit 1: Introduction
1. Intrinsic and extrinsic microbial parameters of foods
2. Sources, types, incidence, and behaviour of microorganisms in food
3. Intrinsic and extrinsic microbial parameters of foods
4. Determination and detection of microorganism in food
5. Microbiological examination of surfaces and their sampling

Unit 2: Spoilage technology
1. Spoilage of fruits and Vegetables
2. Spoilage of Fresh and Processed poultry and meat
3. Spoilage of Sea foods
4. Spoilage of Miscellaneous Foods

Unit 3: Preservation Technology
1. Food preservation: High and Low Temperature
2. Drying, Characteristics of Radiations of Interest in Food Preservation
3. Food additives -colouring, flavours and vitamins
4. Organisms and their use in pickling, producing colour and flavours
5. Alcoholic beverages and other products

PART-B
Unit 4: BIOPOLYMERS IN PACKAGING

1. Synthetic polymer/biopolymer mixtures
2. Microbial polymer
3. Packaging composed of polymers of agricultural origin
4. Process of production of edible films and coating: -Simple coacervation, Complex coacervation, Gelification or thermal coagulation

Unit 5: PROPERTIES OF BIOPACKAGING
1. Organoleptic properties
2. Mechanical Properties
3. Water and Lipid solubility
4. Gas, solute, lipid and water vapor permeability

Unit 6: BIOPACKAGING APPLICATIONS AND LEGISLATIONS
1. State of the art in Bio packaging of foods
2. Potential Food Application as compared to conventional food packaging in : Beverages, Frozen Foods, Dry Products
3. Safety and Food Contact legislations
4. Biobased material and common EU legislations
5. Assessment of Potentially undesirable interactions between packaging material and food stuff.

Text Books/Reference Books:
1. Modern Food Microbiology: Jay J.M., VNR Publication, New York (2005).
2. Food Microbiology: Adams M.R., Royal Society of Chemistry, Publication (2008).
3. Food Science: Potter, N.M. The AVI Publishing Co, Westport Connecticut, USA (2007).

Web links:

1. http://nptel.ac.in/courses/103103029/34
2. http://nptel.ac.in/courses/103103029/35
3. http://nptel.ac.in/courses/103107088/module1/lecture1/lecture1.pdf
   https://agritrop.cirad.fr/594149/1/ID594149.pdf
4. http://www.biodeg.net/fichiers/Book%20on%20biopolymers%20(Eng).pdf

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-627.1	2	3	2	2	3	2	-	-	1	1	2	2	3	2	3	2
BBT-DS-627.2	3	2	1	1	2	2	-	-	1	1	2	3	3	3	2	1
BBT-DS-627.3	2	3	1	2	2	2	-	-	2	1	2	1	2	2	1	1
BBT-DS-627.4	3	3	1	2	2	1	1	-	2	1	3	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-628: BIOFERTILIZERS AND BIOPESTICIDES

	Max Marks	:200
L: 3 T: 0 C- 3	Continuous evaluation	: 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination	:100

Course Outcome:
The students will be able to :
BBT-DS-628.1 fundamental concepts of biopesticides and biofertilizers and their role in sustainable agriculture.
BBT-DS-628.2 describe various mechanisms employed by plant growth promoting microorganisms and types of nitrogen fixation process.
BBT-DS-628.3 accomplish large-scale production of various biofertlizer and biocontrol strains and will have a clear insight of the most common biocontrol mechanisms exhibited by various bioconrol strains
BBT-DS-628.4 build up a knowledge regarding tools and strategies of integrated pest management along with their financial and social aspects.

PART-A

Unit 1: Nitrogen Fixing Bacteria
1.1 Free living, symbiotic (rhizobial, actinorhizal), associative and endophytic nitrogen fixers including cyanobacteria
1.2 Nodule formation, competitiveness and quantification of Nitrogen fixed.
1.3 Mechanism of nitrogen fixation. The Nif genes: Genetics of Nif in *Klebsiella pneumoniae*, Structure and regulation of nif genes in *Klebsiella pneumoniae*

Unit 2: Plant growth promoting Micro-organisms
2.1 Mineral Phosphate solubilizing microorganisms
2.2 Potassium solubilizing microorganisms and other mineral solubilizing bacteria
2.3 Plant growth hormone releasing microbes and other beneficial microbes.

Unit 3: Mass Production of Biofertilizers
3.1 Different agriculturally important beneficial microorganisms
3.2 Selection, establishment, competitiveness of inoculants
3.3 Mass scale production
3.4 Quality control of bio inoculants

PART-B

Unit 4: Blue Green Algae (BGA)
4.1 Nitrogen transformations in low land rice ecosystem
4.2 Heterocyst, modes of nitrogen fixation in BGA
4.3 Isolation of BGA
4.4 Mass cultivation, manipulation of BGA in the rice field and effect of inoculation on the yield of rice.
4.5 Azolla and green manure.

Unit 5: Biopesticide and their Application
5.1 Biocontrol: concept and applications
5.2 Mechanisms of biocontrol, established biocontrol agents
5.3 Application of pesticides and biocontrol agents: Seed dressing, soaking, root-dip treatment, dusting,
5.4 spraying (low and high volume sprayers)
5.5 Soil disinfestations, soil fumigation

Unit 6: Integrated Pest Management
6.1 The concept and history of pest management
6.2 Tools of pest management:
6.3 Cultural, Biological, chemical, genetic, legal and other control tactics and their integration for pest management.

Text Books/Reference Books:
1. Biological Nitrogen Fixation: Stacey, Burris and Evans(ed)., CBA Publishers and Distributor, New Delhi, India.
2. Biofertilizer in agriculture and Forestry: Rao, N.S.S.1996.. Oxford &IBM Pvt Ltd. Publication.
3. Principles of Insect Pest Management: Dhaliwal,G.S. and Arora,R.1998, Kalyani Publication, New Delhi
4. Modern Soil Microbiology: - Van Elsas JD, Trevors JT & Wellington EMH. 1997. CRC Press Publication.
5. Integrated Pest Management: Dent, D. 1995. Chapman and Hall Publication, London
6. The Fundamentals of Nitrogen Fixation: Postagate J.R. 1982., Cambridge University Press Publication.

Web links:
http://nptel.ac.in/courses/126104003/
http://nptel.ac.in/courses/126104001/
http://nptel.ac.in/courses/103107086/
http://www.amm-mcrc.org/publications/Biofertilizers.pdf

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BBT-DS-628.1	2	2	2	2	2	2	-	-	1	1	1	1	3	3	1	1
BBT-DS-628.2	2	2	2	2	2	2	-	-	1	1	1	1	3	3	1	1

| BBT-DS-628.3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| BBT-DS-628.4 | 3 | 2 | 2 | 2 | - | 1 | 1 | - | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |

7thSEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

PROJ-BT-701: INTERNSHIP

Periods/week	Credits	Max. Marks	: 900
Minimum 20 Weeks	10	Continuous Evaluation	: 600
Duration of Ext. Exam: 2 Hrs		End Semester Examination: 300	

Pre-requisites: None
Course Type: Internship

Course Outcome:
The students will be able to-
PROJ-BT-701.1 learn to communicate effectively in corporate/ industry set-up.
PROJ-BT-701.2 improve the requisite skills in biotechnology
PROJ-BT-701.3 pursue research on relevant problems
PROJ-BT-701.4 demonstrate the ethical practices in industry.

Every student will have to undergo Industrial Training for 24 weeks in the relevant field of Engineering in which he/she is enrolled for B.Tech programme after $5^{th}/6^{th}$ semester. Respective Head of Department will approve the Industry/Organization for training.   During this course of time he/she will be regularly monitored and evaluated. Before he is again registered for next semester i.e. $7^{th}/8^{th}$ semester of studies, the student will have to submit the training report, deliver a seminar about the work/project undertaken during the training and will have to appear for viva. The evaluation of the industrial training shall be made as per following:

Continuous Evaluation during training:
1. Evaluation by the Supervisor in the Industry   :   400 marks
2. Evaluation by Faculty during training (2 times)   : 2X100= 200 marks
                Total Continuous evaluation Marks   :   **600**

End Semester Examination Evaluation after training:
1. Project Report   :   100 marks
2. Seminar/Presentation   :   50 marks
3. Viva   :   150 marks

          Total End Semester Examination marks   300

Total Credits   :   14

The parameters for evaluation during the training for Supervisor shall be as under:

		Marks
a)	Work/Project undertaken	50
b)	Punctuality	25
c)	Regularity	25
d)	Discipline	25
e)	Overall Conduct	50
f)	Willingness to Work	25
g)	Innovation	25
h)	Resourcefulness in acquiring technical knowledge	100
i)	Relations with Seniors and others	25
j)	Overall Proficiency achieved during training	25
k)	Any contribution to the organization	25

	Total	**400**

The parameters for evaluation by the faculty during training shall be as under:
1. Visit by faculty members – MRIIRS

a)	Maintenance of Training Diary and Regularity	20
b)	Relations with Seniors and others	20
c)	Overall Conduct	20
d)	Willingness to Work	20
e)	Proficiency achieved	20

2. Mid Semester Evaluation

a) Presentation by student	50
b) Viva	50

	200

Course Articulation Matrix

INTERNSHIP	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
PROJ-BT-701.1	3	3	1	2	3	3	2	2	2	2	3	3	3	3	3	2
PROJ-BT-701.2	3	3	1	3	3	1	1	1	2	1	3	3	3	3	3	1
PROJ-BT-701.3	2	2	1	3	3	1	1	1	1	1	2	2	3	3	3	1
PROJ-BT-701.4	2	2	3	1	1	3	3	3	2	3	2	2	1	1	1	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

PROJ-BT-702: SUMMER INTERNSHIP II

Credits: 2

Max. Marks   :100
Continuous Evaluation   : 100

Pre-requisites: None

Each student is required to accomplish at least 4 Weeks of Internship/ Training at the end of Sixth Semester and before the commencement of Seventh semester, i.e. in the month of June- July. The training shall be conducted outside the institution and shall aim to hone the skills of students. The students can opt for training at a research organization or a reputed industry related to the domain of Biotechnology. The evaluation of this Internship/ training is to be done as continuous evaluation based on their regularity and overall performance during the Internship. The marks of this evaluation shall be included in the result of Seventh Semester.

Course Articulation Matrix

8thSEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-801: STEM CELL TECHNOLOGY

Periods/week Credits	Max. Marks : 200
L: 3 T:0 3	Continuous Evaluation : 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination: 100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcomes:

The students will be able to
BBT-DS-801.1 discover the potential of stem cells in animal systems.
BBT-DS-801.2 categorize the stem cells used for different therapeutic purposes
BBT-DS-801.3 analyze the categories of stem cells for applications in healthcare
BBT-DS-801.4 propose new stem cell based therapy to overcome the shortcomings of existing
                   approaches

PART-A

Unit 1: Basics of Stem cells
1.1 Stem cells: Introduction and properties
1.2 Types of stem cells: ES cells, HSC cells
1.3 Mesenchymal stem cells, Adult stem cells
1.4 Stem cell niches

Unit 2: Molecular Mechanisms of Stem Cells
2.1 Molecular basis of Pluripotency
2.2 Molecular basis of Self-Renewal
2.3 Ion Channels in stem cells
2.4 Epigenetics Modification

Unit 3: Signaling Pathways in Stem cells
3.1 WntSignaling
3.2 Notch
3.3 Hedgehog Signaling
3.4 Signaling in cancer stem cells

PART-B

Unit 4: Stem Cell Technologies I
4.1 Somatic Cell Nuclear Transfer: Cloning and applications
4.2 SCNT: Limitations and Controversies
4.3. Methods of producing human pluripotent cells
4.4 Induced pluripotent stem cell Technology: Production and Applications

Unit 5: Stem Cell Technologies II
5.1 Therapeutic cloning Technology
5.2 Bone marrow Transplantation and applications
5.3 Gene therapy Technology and Applications
5.4 CRISPR Technology and Applications

Unit 6: Stem cells in Regenerative Medicine

6.1 Stem cells in Nervous system repairing
6.2 Stem cells in Cardiac repair
6.3 Stem cells for diabetes
6.4 IPR issues in stem cell technologies

Text Books/ Reference Books:

1. Robert Lanza, 2013, Essential of stem cell biology, Elsevier Science & Technology Books Publication.
2. Marshak, 2001, Stem Cell Biology, Cold Spring Harbar Symposium Publication.
3. S. Sell, 2003, Stem Cell Handbook, Humana Press Publication
4. W. J. Williams, Ernest Beutler and M. A. Lichtman, Hematology,McGraw Hill Professional Publication.
5. B. Alberts, D. Bray, J. Lewis, Molecular Biology of the Cell, 3rd Edition, Macmillan Publication.
6. Marshak, Stem Cell Biology, 2001, Cold Spring Harbar Symposium Publication.

Web links:

https://online.stanford.edu/courses/xgen204-stem-cell-therapeutics
http://www.biolim.org/programmes/online-courses/open/certificate-course-on-stem-cells/
https://stemcells.nih.gov/info/2001report/chapter11.htm
http://nptel.ac.in/courses/105104102/4
https://www.nature.com/articles/ni0402-318?proof=t
https://www.broadinstitute.org/what-broad/areas-focus/project-spotlight/questions-and-answers-about-crispr

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Continuous Evaluation:

Sessional I   - 30 Marks
Sessional II   - 30 Marks
Assignments   - 20 Marks
Class Work/Performance - 10 Marks
Attendance   - 10 Marks

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-801.1	3	3	3	2	2	2	-	-	1	1	1	2	3	3	2	1
BBT-DS-801.2	3	3	3	3	3	2	2	2	1	2	2	3	3	3	2	1
BBT-DS-801.3	2	3	3	3	2	1	1	-	2	1	2	1	2	2	1	1
BBT-DS-801.4	3	3	3	3	2	2	2	1	2	2	3	2	3	2	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-802 PRECISION MEDICINE & WELLNESS

Periods/week Credits		Max. Marks : 200
L: 3 T: 0 3		Continuous Evaluation : 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-851   PRECISION MEDICINE AND WELLNESS LAB

Periods/week   Credits
P: 3   1.5
Duration of Examination: 3 Hrs

Max. Marks   : 100
Continuous Assessment   : 50
End Semester Examination : 50

Course outcomes:
The students will be able to-
BBT-DS-851.1 Understand and perform basic tests such as blood sugar test , Blood Pressure Monitoring and Pulse rate for interpretation of life style diseases
BBT-DS-851.2 Differentiate and identify different blood groups, hemoglobin and interpret the RBC indices
BBT-DS-851.3 Interpret serological tests results for the identification of LFT, KFT and Viral infection
BBT-DS-851.4 Learn the application of precision medicine for the diagnosis and treatment of disease and cancer

List of Experiments:

1. Demonstration of the use of glucometer and Interpretation of result.
2. Measurement of Blood Pressure systolic and Diastolic and interpretation by pulse rate
3. Testing of Blood Groups and Interpretation of result
4. Determination of Haemoglobin and interpretation of RBC indices
5. Detection of Fungal Infection
6. Interpretation of urine microscopy and routine
7. Interpretation of Liver function test results
8. Interpretation of Kidney function test results
9. Common serological markers for viral Infections
10. Case study on Precision Medicine related to genetic disorder
11. Case study on Precision Medicine related to cancer

Text Books/ Reference Books:

1. Nader Rifai, Carl T. WittwerAndrea Rita Horvath2018,Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics, 8e: South Asia Edition,Elsiever
2. K L Mukherjee,1991, Medical Lab Technology, Volume 1 and 2, 2nd Edition, Tata McGraw-Hill Education.
3. Anne M. van Leeuwen MA BS MT,Mickey L. Bladh RN MSM ,2017, Davis's Comprehensive Manual of Laboratory and Diagnostic Tests With Nursing Implications 9th Edition, F.A dais Company

Website:
https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/blood-test
https://www.manual.co/wellness

Distribution of Continuous Assessment

Viva I	30%
Viva II	30%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Course Articulation Matrix

CO Statement (BBT-DS-851)	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O 2	PS O 3	PSO 4
BBT-DS-851.1	3	3	2	2	1	2	3	1	1	2	1	1	1	3	2	-
BBT-DS-851.2	3	3	1	-	1	2	3	1	1	2	1	1	1	2	2	-
BBT-DS-851.3	3	3	1	2	1	2	3	1	1	2	1	1	1	3	2	1
BBT-DS-851.4	3	3	-	-	1	2	3	1	1	2	1	1	-	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

PROJ-BT-801: MAJOR PROJECT

Periods/week   Credits   Max. Marks   : 300
P:24   5   Continuous Evaluation   : 200
Duration of Ext. Exam: 3 Hrs   End Semester Examination: 100

Pre-requisites: None
Course Type: Project

Course outcomes:
The students will be able to-
PROJ-BT-801.1 survey and review relevant previous work literature to identify the research gaps.
PROJ-BT-801.2   formulate a meaningful and worthwhile research problem that is necessary to bridge the research gap as identified through literature survey.
PROJ-BT-801.3   work collaboratively with other researchers, demonstrating effective communication and problem-solving skills.
PROJ-BT-801.4 demonstrate the responsible conduct of research with high degree of ethics and standards.

Every student will have to undertake a research project in the field relevant to Biotechnology. The student can either pursue the project work in-house or in a reputed industry or research organization, which will be approved by the respective Head of Department. During this course of time he/she will be regularly monitored and evaluated by the Departmental Project Committee/ Continuous evaluation Supervisor/ Project Co-ordinator. Continuous monitoring will include Mid Term Review Presentations and Feedback from supervisor. After completion of the Major Project, each student will have to submit the Project report (hard bound), deliver a presentation pertaining to research work undertaken and will have to appear for viva during End Semester Examination.

Continuous Evaluation:
Continuous Performance Review-I   - 100 Marks
Continuous Performance Review-II   - 100 Marks
Feedback from Supervisor   - 100 Marks
Presentation   - 100 Marks
Project Report   - 100 Marks
Attendance   - 100 Marks

Course Articulation Matrix

MAJOR PROJECT (PROJ-BT-801)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
PROJ-BT-801.1	3	3	2	3	3	2	3	2	1	2	1	3	3	3	3	3
PROJ-BT-801.2	2	3	2	3	2	2	3	2	1	2	1	3	3	3	3	3
PROJ-BT-801.3	3	3	2	3	3	2	3	2	2	2	3	3	3	3	3	2
PROJ-BT-801.4	1	2	1	1	1	1	1	1	3	3	3	3	2	2	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

GP-BT-800GENERAL PROFICIENCY

Periods/week   Credits
L: 0P: 2   1
Duration of Ext. Exam: 3 Hrs

Max. Marks   : 100
End Semester Examination: 100

Pre-requisites: None
Course Type: General

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-824: DRUG DISCOVERY & DESIGNING

Periods/week   Credits
L: 3   T: 0   3
Duration of Ext. Exam: 3 Hrs

Max. Marks   :200
Continuous Evaluation   :100
End Semester Examination:100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcomes:
The students will be able to-
BBT-DS-824.1 describe the process of drug discovery and development
BBT-DS-824.2 discuss the challenges faced in each step of the drug discovery process
BBT-DS-824.3 apply computational methods for drug discovery
BBT-DS-824.4 appraise scientific, ethical and market-related considerations of importance in drug discovery and development

PART-A

Unit 1: Introduction to drug discovery/development
1.1 Definition, stages and strategic issues in drug discovery
1.2 Sources of drugs: Plants, animals and microorganisms
1.3 Drug Properties
1.5 Sequence of events after drug administration

Unit 2: Drug Targets
2.1 Target identification and validation:
2.2 Enzymes as drug targets: Enzyme inhibitors and activators, Approaches to the Design of Enzyme Inhibitors
2.3 Receptors as drug targets: Hormone receptors and GPCR
2.4 DNA and RNA as drug targets

Unit 3: Biologics as drugs
3.1 Antibodies
3.2 Vaccines
3.3 Petidimimetics
3.4 Vaccines
3.6 Pharmacokinetics and Pharmacodynamics modeling

PART-B

Unit 4: New drug discovery
4.1 Rational drug design concept
4.2 Assay Development
4.3 High Throughput Screening
4.4 Drug repositioning strategy: 2-DG as example
4.5 Prodrugs

Unit 5: Computer aided drug design

6.1. Review of Protein Structures: Primary, secondary, tertiary and quaternary
6.2. Viewing Tools and Graphics Tools: Rasmol, Deep View, VMD, Raster3D
6.3. Homology Modeling and generation of 3D Protein Structure
6.4. Molecular and Quantum Mechanics
6.5. Energy Minimization methods
6.6 Docking
6.7 Virtual Screening

Unit 6: Pre-Clinical and Clinical testing

6.1 Pre-clinical toxicology In vitro
6.2 Pre-clinical toxicology In vivo
6.3 One case study

Text Books/Reference Books:

1. E.H.Kerns,L. Di, 2008, Drug-Like Properties: Concepts, Structure Design and Methods: from ADME to Toxicity Optimization, Academic Press.
2. M. E. Wolff,1995, Burger's Medicinal Chemistry and Drug Discovery, 5th Edition, Vol. 1. Principles and Practice, edited by, John Wiley & Sons,New York.
3. W.O. Foye, T.L. Lemke, andD. A. Williams,1995, Principles of Medicinal Chemistry, 4th Edition, Williams and Wilkins: Philadelphia.
4. F.D. King,1994, Medicinal Chemistry: Principles and Practice, edited by, Royal Society of Chemistry: Cambridge.
5. A. W. Czarnik and S. H.DeWitt,1997, A Practical Guide to Combinatorial Chemistry, edited by, American Chemical Society: Washington DC.
6. Richard B. Silverman,2004, The organic chemistry of drug design. Second edition, Elsevier.
7. Graham L. Patrick, 2009, An introduction to Medicinal Chemistry,Fourth edition, Oxford.

Web links:

http://www.sciencedirect.com/science/article/pii/S1074552103001947
http://www.yourgenome.org/facts/how-are-drugs-designed-and-developed
https://www.nature.com/subjects/structure-based-drug-design

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BBT-DS-824.1	3	3	2	3	2	3	2	3	3	2	2	2	3	3	3	2
BBT-DS-824.2	2	2	2	2	2	3	2	3	2	2	2	3	3	3	3	2
BBT-DS-824.3	3	3	3	3	3	3	2	3	3	2	3	2	3	3	3	2
BBT-DS-824.4	3	3	3	3	3	3	3	2	2	2	3	3	3	3	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-825: MOLECULAR THERAPEUTICS

Periods/week	Credits	Max. Marks : 200
L: 3	T: 0	3	Continuous Evaluation : 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcomes:
The students will be able to
BBT-DS-825.1 become familiar with basic concepts of Molecular Therapeutics.
BBT-DS-825.2interpret the scientific basis of developing a therapeutic.
BBT-DS-825.3analyze different therapies needed for curing a disorder/disease.
BBT-DS-825.4select and propose a suitable therapy amongst various therapeutics against a disorder/disease.

PART-A
Unit 1: Gene Therapy
1.1 Gene therapy
1.2 Intracellular barriers to gene delivery
1.3 Overview of inherited and acquired diseases for gene therapy
1.4 Retrovirus mediated gene transfer
1.5 Liposome and nanoparticles mediated gene delivery

Unit 2: Cellular Therapy
2.1 Stem cells: definition, properties and potency of stem cells
2.2 Sources: embryonic and adult stem cells
2.3 Concept of tissue engineering
2.4 Role of adult and embryonic stem cells
2.5 Stem cell therapies to treat genetic diseases

Unit 3 Recombinant Therapy
3.1 Recombinant therapy
3.2 Insulin analogs and its role in diabetes
3.3 Streptokinase and urokinase in thrombosis
3.4 Recombinant human growth hormone and coagulation factors

PART-B
Unit 4: Immunotherapy
4.1 Immunotherapy
4.2 Role of recombinant interferons
4.3 Immunostimulants and Immunosupressors in organ transplants
4.4 Role of cytokine therapy in cancers
4.5 Vaccines and its types

Unit 5: Gene Silencing Technology
5.1 Gene silencing technology

5.2 Antisense therapy: si RNA
5.3 Tissue and organ transplantation
5.4 Cloning
5.5 Transgenics and their uses

Unit 6: Clinical Applications and Ethical Issues
6.1 Clinical applications of cellular therapy
6.2 Clinical applications of recombinant technology: Erythropoietin
6.3 Clinical application of monoclonal antibodies and their role in cancer
6.4 Clinical application of recombinant vaccines
6.5 Ethical issues related to molecular therapies

Web links:
http://nptel.ac.in/courses/102103041
nptel.ac.in/courses/102103013/module8/lec4/3.html
nptel.ac.in/courses/102103016/module5/lec41/5.html

Text Books/Reference Books:
1. B. Palsson and S. N. Bhatia,2004. Tissue Engineering, 2nd Edition, Prentice Hall.
2. P, Greenwell and M. McCulley,2008, Molecular Therapeutics: 21st century medicine, 1st Edition, Sringer.
3. M.A.Camphell , and L.J.Heyer,2007, Discovering Genomics, Proteomics and Bioinformatics , 2nd Edition , CSHL Press ,Pearson/ Benzamin Cummings San Francisco, USA.
4. J. W. Goding,1996, Monoclonal antibodies; Principles and Practice , 3rd Edition , Academic Press.
5. L. Buchingham and M. L. Flawsm,2007,Molecular Diagnostics; Fundamentals, Methods and Clinical Application, 1st Edition F.A. Davis Company Philadelphia USA.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering the entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Students need to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-825.1	2	2	1	3	2	-	2	-	1	1	1	-	2	2	2	-
BBT-DS-825.2	2	2	2	2	1	-	-	-	-	-	-	1	1	1	2	-
BBT-DS-825.3	2	2	1	2	1	-	1	1	-	-	2	2-	2	1	2	2

| BBT-DS-825.4 | 2 | 2 | 2 | 2 | 1 | 1 | - | 1 | - | - | - | 1 | 1 | 2 | 2 | 2 |

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-826:GREEN BIOTECHNOLOGY AND POLLUTION ABATEMENT

Periods/week   Credits   Max. Marks   : 200
L: 3   T: 0   3   Continuous Evaluation   : 100
Duration of Ext. Exam: 3 Hrs   End Semester Examination: 100

Pre-requisites: knowledge of basic 10+2 science
Course Type: Domain specific

Course Outcomes:
The students will be able to-

BBT-DS-826.1 become familiar with basic concepts of environment conservation.
BBT-DS-826.2 implement the concepts of biotechnology for waste management, bioremediation and
                green energy.
BBT-DS-826.3 apply biotechnologyin monitoring or removing the pollutants
BBT-DS-826.4 embracenew trends such as biofuels and renewable energy to minimize the harmful
                impact of pollutants thereby making the planet earth a better dwelling place.

PART-A
Unit 1: Biological Waste Treatment
Principles and design aspects of various waste treatment methods with advanced bioreactor configuration: Solid waste management: landfills, recycling and processing of organic residues, minimal national standards for waste disposal.

Unit 2: Biodegradation of Xenobiotic Compounds
Xenobiotic compounds–Definition, examples and sources. Biodegradation- Introduction, effect of chemical structure on biodegradation, recalcitrance, co metabolism and biotransformation. Factors affecting biodegradation, microbial degradation of hydrocarbons.

Unit 3: Biotransformations and Biocatalysts
Basic organic reaction mechanism- Common prejudices against enzymes, advantages & disadvantages of biocatalysts, isolated enzymes versus whole cell systems, biocatalytic application, catalytic antibodies; stoichiometry.

PART-B
Unit 4: Bioremediation and Biorestoration
Introduction and types of bioremediation, bioremediation of surface soil and sludge, bioremediation of subsurface material, In situ and Ex-situ technologies, phytoremediation- restoration of coal mines a case study. biorestoration: reforestation through micropropagation, use of mycorrhizae in reforestation, use of microbes for improving soil fertility, reforestation of soils contaminated with heavy metals.

Unit 5:Eco-Friendly Bioproducts from Renewable Sources
Fundamentals of composting process: scientific aspects and prospects of biofuel production: bioethanol, biohydrogen and biodiesel; biofertilizers and biopesticides.

Unit 6: Biotechnology in Environment Protection

Current status of biotechnology in environment protection and its future, release of genetically engineered organisms in the environment.

Text Books/References:

1. J. Winter,Environmental Processes I-III, 2nd ed., Wiley Publications
2. R. S. Ramalho, Introduction to Wastewater Treatment, Academic Press.
3. O.P. Gupta. Elements of Water Pollution Control Engineering, Khannabooks.
4. O.P. Gupta, 2018Energy Technology, Khannabooks.
5. B. Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.
6. B.C. Bhattacharya &Ritu Banerjee, 2007,Environmental Biotechnology,Oxford Press.
7. PradiptaKrimar,2006, Environmental Biotech, , I.K. International Pvt. Ltd.
8. D.P. Singh, S.K. Dwivedi,2004,Environmental Microbiology & Biotechnology,New Age International Publishers.
9. Martin Alexander,1999, Biodegradation and Bioremediation, 2nd edition, Elsevier Science & Technology.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering the entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Students need to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO (BBT-DS-826)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
BBT-DS-826.1	3	3	2	2	2	-	-	-	1	-	-	2	3	3	2	-
BBT-DS-826.2	3	3	3	3	3	2	2	-	2	1	3	3	2	2	1	1
BBT-DS-826.3	3	1	-	2	2	-	-	-	2	1	2	1	-	1	1	-
BBT-DS-826.4	3	3	2	2	2	2	2	-	2	1	3	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-DS-827: NUTRACEUTICALS AND FUNCTIONAL FOODS

Periods/week   Credits   Max. Marks   : 200
L: 3   T: 0   3   Continuous evaluation   : 100
Duration of Ext. Exam: 3 Hrs   End Semester Examination   :100

Course Outcomes:
BBT-DS-827.1: The students will be able to have a general knowledge on development of functional foods and nutraceuticals.
BBT-DS-827.2: The students will be able to distinguish differences between conventional foods vs. functional foods as well as nutraceuticals vs. pharmaceuticals.
BBT-DS-827.3: The students will be able to list potential health benefits of common functional foods and nutraceutical
BBT-DS-827.4: The students will learn the concept of treatment of important diseases through improved nutrition or the development of targeted health promoting foods and beverages.

PART-A

Unit 1:   Introduction to Nutraceuticals and functional Foods –
1.1   Basis of claims for a compound as a nutraceuticals
1.2   Regulatory aspects for nutraceuticals / functional foods including CODEX
1.3   Classification of nutraceuticals and functional foods.

Unit 2: Functional Properties of Nutraceuticals
2.1   Lycopene, Isoflavanoids
2.2   Concept of Antioxidants: omega – 3 fatty acids
2.3   Dietary fiber
2.4   Phytoesterols
2.5   Glucosinates, Glucosamines
2.6   Mushroom extracts

Unit 3: Isolation of phytochemicals from plant materials:
3.1 Isoprenoids, Isoflavones, and Flavonoids,
3.2 Terpenoids, carotenoids,
3.3 Polyunsaturated fatty acids,
3.4 Sphingolipids, lecithin, & choline
PART B
Unit 4: Prebiotics, probiotics and symbiotics
4.1 Probiotics: Definition, types and benefits
4.2 Usefulness in gastro intestinal health and other health benefits;
4.3 Prebiotics: Prebiotic ingredients in foods;
4.4 Types of prebiotics and their effects on gut microbes;
4.5 Symbiotics.

Unit 5 Role of Functional Foods in Health
5.1 Obesity, Diabetes
5.2 Cardiovascular health
5.4 Arthritis

5.5 Nephrological disorders,
5.6 Liver disorders
5.7 Immunoboosters

Unit 6 Recent Advancements in Functional Foods
6.1 Adverse effects and toxicity of nutraceuticals
6.2 nutrigenomics
6.3 Recent advancements and techniques in the formulation and processing of functional foods..
6.4 Nutrigenomics
6.5 Nanotechnology in functional food industry

Text Books/ Reference books
1.	Chukwuebuka Egbuna and G. D. Tupas, 2020,Functional Foods and Nutraceuticals, 1st Edition, Springer
2.	D, A. Vattem and V,Maitin,2016, Functional Foods, Nutraceuticals and Natural Products Concepts and Applications, 1st Edition, DEStech Publications, USA
3.	R.E.C. Wildman, 2007, Handbook of Nutraceuticals and Functional Foods, second edition. CRC Press.
4.	G.R. Gibson andC.M. William,2000, Functional Foods - Concept to Product,CRC Press
5.	I.Goldberg,2004, Functional Foods: Designer Foods, Pharma Foods, Nutraceuticals,Springer.

Web links:
https://fssai.gov.in/cms/health-supplements.php
http://www.pharmaceutical-journal.com/1-what-is-a-nutraceutical/20002095.article
https://www.fda.gov/food/dietary-supplements

Evaluation of outcomes through:
* Everyday evaluations
* Class Test
* Sessional tests
* End Semester exams

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-DS-827.1	1	1	2	3	2	2	3	2	2	2	3	3	2	2	2	1
BBT-DS-827.2	2	2	1	2	3	1	1	3	1	1	1	2	1	1	2	2
BBT-DS-827.3	1	1	1	2	1	1	1	3	2	1	1	2	2	1	1	1
BBT-DS-827.4	1	1	2	1	1	1	2	3	2	1	1	1	1	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BBT-DS-828: HYDROPONICS & AEROPONICS

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3	Continuous evaluation : 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination :100

Course Outcomes:
The students will be able to-

BBT-DS-828.1: Assess theusefulness of controlled environment systems for soil-less agriculture.
BBT-DS-828.2: Relate the physiological functions of plants with environmental conditions necessary for growth in controlled environment systems.
BBT-DS-828.3: Integrate the general principles of plant biology and soil science to plant production systems.
BBT-DS-828.4 Apply the basic principles of soil-less plant production systems to various plants.

PART-A

Unit 1: Overview of Soil-less Agriculture
1.1 General plant physiology
1.2 Root architecture
1.3 Water relations
1.4 Mineral uptake
1.5 Advantages of Soilless Agriculture

Unit 2:   Essential elements for plant growth
2.1 Macronutrients
2.2 Micronutrients
2.3 Elemental deficiency in plants
2.4 Other additives- carbohydrates, plant growth promoters

Unit 3:   Irrigation and Fertigation
3.1 Water quality and irrigation scheduling
3.2 Nutrient solution reagents and formulations
3.3 Fertigation strategy
3.4 Factors affecting growth- pH, Temperature, Electrical conductivity, Oxygenation, CO_2, Light

PART-B

Unit 4:   Hydroponic substrates

4.1 Types of substrates
4.2 Physical and chemical properties of substrates
4.3 Elemental content and interactions of rooting media
4.4 Substrate monitoring and re-use

Unit 5: Systems of hydroponic culture
5.1 Standing Aerated Growing System
5.2 Deep Water Culture (DWC)
5.3 Nutrient Film Technique (NFT)
5.4 Ebb and Flow (Flood and Drain)
5.5 Drip System
5.6 Wicking System

Unit 6: Aeroponics
6.1 Importance of Aeroponics in growing crops
6.2 Components of an Aeroponic System
6.3 Aeroponics system design
6.4 Advantages and disadvantages

Text Books/ Reference books

1. J.B.Jones Jr,2016, Hydroponics: a practical guide for the soilless grower. CRC press.
2. S.Diver and L. Rinehart,2000, Aquaponics-Integration of hydroponics with aquaculture (pp. 1-16), ATTRA.
3. J.S.Douglas,1985,Advanced guide to hydroponics,Pelham Books.
4. T.W.Gurley,2020,Aeroponics: Growing Vertical,CRC Press.

Web links:
https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/hydroponics
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5091364/

Evaluation of outcomes through:
- Everyday evaluations
- Class Test
- Sessional tests
- End Semester exams

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%

Attendance	10%

Course Articulation Matrix

CO Statement BBT-DS-828	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PS O 4
BBT-DS-828.1	1	1	2	3	2	2	3	2	2	2	3	3	3	3	3	3
BBT-DS-828.2	3	3	3	3	3	3	1	3	1	1	1	2	3	3	3	3
BBT-DS-828.3	3	3	3	3	3	3	1	3	2	1	1	2	3	3	3	3
BBT-DS-828.4	2	2	2	2	2	2	2	3	2	1	1	1	3	3	3	3

Appendix A

Course having focus on Regional, National or Global requirements.

Course Code	Course Title	Regional	National	Global
BPH-101	Introduction to Electromagnetic Theory			√
BMA-103	Mathematics for Biotechnology-I			√
BEE-101	Basic Electrical Engineering			√
BME-101	Engineering Graphics & Design			√
BPH-151	Physics Lab			√
BEE-151	Basic Electrical Engineering Lab			√
BHM-101	Professional Communication		√	√
BHM-MC-001	Constitution of India	√	√	
BCH-100	Chemistry			√
BMA-203	Mathematics for Biotechnology-II			√
BCS-101	Programming for Problem Solving			√
BME-102	Workshop / Manufacturing Practices		√	
BHM-201	English		√	√
BCH-151	Chemistry Lab			√
BCS-151	Programming for Problem Solving Lab			√
BHM-151	English Lab			√
BCH-MC-002	Environmental Science	√	√	
BBT-DS-301	Cell Biology			√
BBT-DS-302	Microbiology			√
BBT-DS-303	Biochemistry			√
BBT-DS-304	Bioanalytical Techniques			√
BBT-DS-305	Bioinformatics & Computer Applications			√
BBT-DS-351	Cell Biology Lab			√
BBT-DS-352	Microbiology Lab			√
BBT-DS-353	Biochemistry & Bioanalytical Techniques Lab			√
BBT-DS-354	Bioinformatics & Computer Applications Lab			√
RIC (E) - 300	Research and Innovation Catalyst-I			√
BHM-MC-004	Quantitative Aptitude			√
PROJ-BT-	Summer Internship I	√	√	

Code	Course			
300				
BBT-DS-401	Molecular Biology		√	
BBT-DS-402	Immunology		√	
BBT-DS-403	Fermentation Technology		√	√
BBT-DS-404	Biostatistics		√	√
BBT-DS-405	Biosafety, Bioethics & IPR			√
BBT-DS-451	Molecular Biology Lab	√	√	
BBT-DS-452	Immunology Lab	√	√	
BBT-DS-453	Fermentation Technology Lab	√	√	
BBT-DS-454	Biostatistics Lab	√	√	
RIC (E) - 400	Research and Innovation Catalyst-II			√
BHM-MC-006	Quantitative Aptitude & Personality Development-I			√
BHM-MC-001	Constitution of India	√	√	
BT-501A	Recombinant DNA Technology		√	√
BT-506A	Animal Biotechnology	√		
BT-508	Bioprocess Engineering		√	
BT-531	Introduction to Pharmaceutical Technology		√	
BT-537	Food Microbiology	√		
BT-532	Introduction to Biomaterials		√	√
BT-538	Food Process Technology	√		
CS-405	Cyber Security		√	√
BT-511A	Recombinant DNA Tech. Lab	√	√	
BT-516	Bioprocess Engineering Lab	√	√	
BT-500	Technical Seminar-II			√
HM-507	German I			√
HM-505A	Quantitative Aptitude and Personality Development-II			√
BT-601A	Plant Biotechnology	√		
BT-602A	Environment Biotechnology	√		
BT-507	Food Biotechnology	√		
BT-631	DNA Microarrary Technology		√	
BT-637	Food Packaging Technology	√	√	
BT-632	Drug Designing		√	√
BT-638	Nutraceuticals & Functional Foods		√	√
BT-613	Cell & Tissue Culture Lab	√		
BT-612A	Environment Biotechnology Lab	√		
BT-515	Food Biotechnology Lab	√		
BT-651	Minor Project	√		

COM-306A	Entrepreneurship Development	√	√	
HM-607	German II			√
HM-603A	Quantitative Aptitude and Personality Development-III			√
HM-604	Holistic wellness and life Skills-III			√
BT-800	Industrial Training		√	√
BT-702	Biosafety, Bioethics & IPR			√
BT-703	Stem Cells & its applications		√	
BT-831	Drug Delivery Systems		√	√
BT-832	Molecular Therapeutics		√	√
BT-834	Entrepreneurship Opportunities in Food Industries		√	
HM-822	Human Resource Management		√	
BT-700	Major Project			√
BT-750	Collouquim			√

Appendix B

Courses catering to the need of Employability, Entrepreneurship or Skill development requirements

Course Code	Course	Employability	Entrepreneurship	Skill development
BBT-DS-305	Bioinformatics & Computer Applications			√
BBT-DS-403	Fermentation Technology	√		
BBT-DS-405	Biosafety, Bioethics & IPR		√	
BT-501A	Recombinant DNA Technology			√
BT-506A	Animal Biotechnology	√		
BT-508	Bioprocess Engineering			√
BT-531	Introduction to Pharmaceutical Technology	√		
BT-537	Food Microbiology	√		
BT-532	Introduction to Biomaterials	√		
BT-538	Food Process Technology		√	
CS-405	Cyber Security			√
BT-601A	Plant Biotechnology		√	
BT-602A	Environment Biotechnology		√	
BT-507	Food Biotechnology		√	
BT-631	DNA Microarrary Technology			√
BT-637	Food Packaging Technology		√	
BT-632	Drug Designing			√
COM-306A	Entrepreneurship Development		√	
BT-702	Biosafety, Bioethics & IPR		√	
BT-831	Drug Delivery Systems			√
BT-832	Molecular Therapeutics			√
BT-834	Entrepreneurship Opportunities in Food Industries		√	
HM-822	Human Resource Management	√		

Appendix C

Courses catering to the need of Environment and Sustainability, Professional Ethics, Human Values or Gender equality requirements

Course Code	Course	Environment & Sustainability	Professional Ethics	Human Values
BCH-MC-002	Environment Science	√		
BT-535	Waste Water Treatment	√		
BT-536	Biofertilizers & Biopesticides	√		
BT-602A	Environment Biotechnology	√		
BT-635	Bioremediation Technology	√		
BT-636	Bioenergy & Biofuels	√		
BT-612A	Environment Biotechnology Lab	√		
BT-833	Biodiversity Conservation	√		
C-825	Remote Sensing and GIS	√		
C-831	Environmental Air Pollution	√		
C-839	Disaster Management	√		
C-634	Solid Waste Management	√		
BBT-DS-405	Biosafety, Bioethics & IPR		√	
BT-702	Biosafety, Bioethics & IPR		√	
CS-405	Cyber Security		√	
COM-306A	Entrepreneurship Development		√	
BT-834	Entrepreneurship Opportunities in Food Industries		√	
HM-621	Marketing and Management in Biotech Products		√	
HM-623	Total Quality Management		√	
HM-822	Human Resource Management		√	
HM-823	Project Management		√	
BHM-MC-001	Constitution of India			√
HM-604	Holistic wellness and life Skills-III			√