

# **School of Bio Sciences and Technology**

## **M.Sc. Bio Medical Genetics**

### Curriculum and Syllabus

(2023 – 2024 admitted students)



**VIT**<sup>®</sup>

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**Vellore Institute of Technology**

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

## **VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY**

- Transforming life through excellence in education and research.

## **MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY**

- World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.
- Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.
- Impactful People: Happy, accountable, caring and effective workforce and students.
- Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development.
- Service to Society: Service to the region and world through knowledge and compassion.

### **Vision Statement of School of Bio Sciences and Technology (SBST)**

- To nurture high-quality bioengineers and science graduates with the potential to innovate, invent and disseminate knowledge for the benefit of society and environment

### **Mission Statement of School of Bio Sciences and Technology (SBST)**

- To offer academic programs to impart knowledge skills to cater to the dynamic needs of the bio sciences and the food industry
- To foster the spirit of innovation and creativity in the young minds in solving the real-time problems arising in society and industry
- To instill confidence, ethics, values, and employability skills in the future citizens to focus on the sustainable growth of the economy

## **School of Bio Sciences and Technology (SBST)**

### **Our Vision**

To nurture high-quality bioengineers and science graduates with the potential to innovate, invent and disseminate knowledge for the benefit of society and environment

### **Our Mission**

- To offer academic programs to impart knowledge skills to cater to the dynamic needs of the bio sciences and the food industry
- To foster the spirit of innovation and creativity in the young minds in solving the real-time problems arising in society and industry
- To instill confidence, ethics, values, and employability skills in the future citizens to focus on the sustainable growth of the economy

### **Mission of M.Sc., Bio Medical Genetics**

- Apply knowledge of genetic principles and understand how they contribute to etiology, clinical features, and disease expression
- Exhibit the knowledge of ethical legal, and social issues pertaining to genetic counselling

## **M.Sc Bio Medical Genetics**

### **PEO Statements**

- PEO1: Excel in professional career and/or higher education by acquiring solid foundation in science, mathematics and advanced technologies
- PEO2: Develop and apply engineering solutions for solving contemporary, social and human issues with realistic constraints suitable for the present need through the use of modern tools.
- PEO3: Exhibit professional and ethical standards, effective communication skills, teamwork spirit, multidisciplinary and transdisciplinary approach for successful careers and to be able to compete globally, function as leaders, as entrepreneurs, and manage information efficiently and engage in lifelong learning

### **Programme Specific Outcomes (PSOs)**

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#### **PSO Statement**

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- 1 Apply knowledge of genetic principles and understand how they contribute to etiology, clinical features, and disease expression.
  - 2 Exhibit the knowledge of ethical legal, and social issues pertaining to genetic counselling
  - 3 Ability to independently carry out research and development work to solve the practical problems
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### Category-wise Credit distribution

Category	Credits
University core (UC)	29
Programme core (PC)	23
Programme elective (PE)	22
University elective (UE)	6
Total credits	80

### Detailed curriculum

#### University Core

SL.No	Course Code	Course Title	L	T	P	J	C
1	ENG5003	English For Sciences and Technology	0	0	4	0	2
3	FRE5001	Francais fonctionnel-TH	2	0	0	0	2
4	GER5001	Deutsch fuer Anfaenger - TH	2	0	0	0	2
5	MSM5001	Biostatistics	2	0	2	0	3
6	STS 4001	Soft Skills	3	0	0	0	1
6	STS4002	Soft Skills	3	0	0	0	1
7	SET5001	SET Project ( I Semester)	0	0	0	0	2
8	SET5002	SET Project ( II Semester)	0	0	0	0	2
9	SET5003	SET Project ( III Semester)	0	0	0	0	2
10	RES5001	Research Methodology	2	0	0	0	2
11	BMG6099	Master's Thesis					14

### Programme Core

SL.N O	Course Code	Course Title	L	T	P	J	C	Pre requisite
1	BMG5001	Biochemistry	3	0	2	0	4	NIL
2	BMG5002	Principles of Genetics	3	0	0	0	3	NIL
3	BMG5003	Human Immunology	3	0	0	0	3	NIL
4	BMG6002	Clinical Cytogenetics and Prenatal Diagnosis	2	0	2	4	4	NIL
5	BMG5004	Human Molecular Genetics	3	0	0	0	3	NIL
6	BMG5007	Developmental Genetics	3	0	0	0	3	NIL
7	BMG5008	Cancer Genetics	3	0	0	0	3	NIL

### Programme Elective

SL. NO	Course Code	Course Title	L	T	P	J	C	Pre requisite
1	BMG5005	Human Anatomy and Physiology	2	0	0	4	3	NIL
2	BMG5006	Advanced Analytical Techniques	3	0	0	0	3	NIL
3	BMG5009	Genetics of Human Infertility	2	0	0	4	3	NIL
4	BMG5010	Radiation Genetics	2	0	0	4	3	NIL
5	BMG5011	Cognitive and Behavioral	2	0	0	4	3	NIL

		Genetics							
6	BMG5012	Forensic Science	2	0	0	4	3		NIL
7	BMG5013	Stem Cell Biology	3	0	0	0	3		NIL
8	BMG5014	Environmental Genetics	3	0	2	0	4		NIL
9	BMG5015	Introduction to Human Psychology*	3	0	0	0	3		NIL
10	BMG5016	Bioinformatics	2	0	2	4	4		NIL
11	BMG5017	Enzymology	3	0	0	0	3		NIL
12	BMG6001	Human Biochemical Genetics	2	0	0	4	3		NIL
13	BMG6003	Medical Biochemistry	3	0	0	0	3		NIL
14	BMG6004	Genetic Engineering	3	0	2	0	4		NIL
15	BMG6005	Genetic Counseling *	2	0	0	4	3		Clinical Cytogenetics and Prenatal Diagnosis.
16	BMG6006	Ethical, Legal and Social Issues in Genetic Counseling*	3	0	0	0	3		Clinical Cytogenetics and Prenatal Diagnosis.
17	BMG6007	Clinical rotation*	0	0	0	0	2		Clinical Cytogenetics and Prenatal Diagnosis.

### University Elective

SL.NO	Course Code	Course Title	L	T	P	J	C	Pre requisite	SL.NO
1		Any course offered to M.Tech ( Subject to CGPA Conditions)/M.Sc Programs.		0	0	0	0	6	



Course code	Course Title	L	T	P	J	C
ENG5003	English for Science and Technology (for MCA & M.Sc., programmes)	0	0	4	0	2
Pre-requisite	Cleared EPT	Syllabus version				
		v. 1.1				
<b>Course Objectives:</b>						
<p>1. To enable students communicate effectively in social, academic and professional contexts thereby enhancing their interpersonal, managerial, problem-solving, and presentation skills.</p> <p>2. To facilitate students develop their listening competency and critically evaluate and review documentaries, talks and speeches.</p> <p>3. To Assist students read and comprehend News Articles and Scientific Texts; effectively interpret tables and graphs; write and proof-read official correspondences.</p>						
<b>Expected Course Outcome:</b>						
<p>1. Make effective presentations and display their interpersonal skills in academic and professional contexts.</p> <p>2. Emerge as good listeners and critically evaluate oral communication.</p> <p>3. Excel in reading, comprehending and interpreting technical reports, texts and data.</p> <p>4. Able to write effectively in English and also display their proof-reading abilities.</p> <p>5. Face real interviews and handle personal and professional conflicts effectively.</p>						
<b>Module:1</b>	<b>Career Goals</b>	<b>4hours</b>				
Short term and long term career goals						
Activity: SWOT Analysis/ Comprehending speeches						
<b>Module:2</b>	<b>Interpersonal Skills</b>	<b>4 hours</b>				
Interpersonal Communication in/with Groups (Corporate Etiquette: Journey from Campus to corporate)						
Activity: Role Plays/Mime/Skit						
<b>Module:3</b>	<b>Listening Skills</b>	<b>4 hours</b>				
Listening to Documentary						

Activity: Critically evaluate/Review a documentary/TED Talk		
<b>Module:4</b>	<b>Reading Skills</b>	<b>4hours</b>
Skimming, Scanning, Intensive & Extensive reading Activity: Reading News Papers/Magazines/Scientific Texts		
<b>Module:5</b>	<b>Report Writing</b>	<b>4hours</b>
Language and mechanics of writing report Activity: Writing a Report/Mini Project		
<b>Module:6</b>	<b>Study Skills</b>	<b>4hours</b>
Summarizing the report Activity: Abstract, Executive Summary, Digital Synopsis		
<b>Module:7</b>	<b>Interpreting skills</b>	<b>4hours</b>
Interpret data in tables and graphs Activity: Transcoding		
<b>Module:8</b>	<b>Editing Skills</b>	<b>4hours</b>
Proof Reading Sequencing Activity: Editing any given text		
<b>Module:9</b>	<b>Presentation Skills</b>	<b>4 hours</b>
Oral Presentation using digital tools Activity: Oral presentation on the given topic using appropriate non-verbal cues		
<b>Module:10</b>	<b>Group Discussion</b>	<b>4 hours</b>
Intragroup interaction (avoid, accommodate, compete, compromise, collaborate) Activity: Group discussion on a given topic		
<b>Module:11</b>	<b>Professional Skills</b>	<b>4 hours</b>
Résumé Writing Activity: Prepare an Electronic Résumé		
<b>Module:12</b>	<b>Skill-Gap Analysis</b>	<b>4 hours</b>
Tailor your skills to suit the Job needs Activity: Write a SoP for higher Studies/Purpose Statement for job		
<b>Module:13</b>	<b>Interview Skills</b>	<b>4 hours</b>
Placement/Job Interview Activity: Mock Interview		
<b>Module:14</b>	<b>Managerial Skills</b>	<b>4 hours</b>
Official Meeting to organize events Activity: Writing Agenda, Minutes of Meeting (video conferencing) and Organizing an event		
<b>Module:15</b>	<b>Problem Solving Skills</b>	<b>4 hours</b>
Conflict Management & Decision Making Activity: Case analysis of a challenging Scenario		

		<b>Total Lecture hours:</b>	<b>60 hours</b>
<b>Text Book(s)</b>			
1.	Kuhnke, E. Communication Essentials For Dummies. (2015). First Edition. John Wiley & Sons.		
2.	Hewings, M. Advanced Grammar in Use Book with Answers and CD-ROM: A Self-Study Reference and Practice Book for Advanced Learners of English. (2013). Third Edition. Cambridge University Press. UK.		
<b>Reference Books</b>			
1.	Churches, R. Effective Classroom Communication Pocketbook. Management Pocketbooks. (2015). First Edition. USA.		
2.	Wallwork, A. English for Writing Research Papers. (2016). Second Edition. Springer.		
3.	Wood, J. T. Communication in Our Lives. (2016). Cengage Learning. Boston. USA.		
4.	Anderson, C. TED Talks: The Official TED Guide to Public Speaking. (2016). First Edition. Boston. Houghton Mifflin. New. York.		
5.	Zinsser, William. On writing well. HarperCollins Publishers. 2016. Thirtieth Edition. New York.		
6.	Tebeaux, Elizabeth, and Sam Dragga. The essentials of Technical Communication. 2015. First Edition Oxford University Press. USA.		
Mode of Evaluation: Mini Project, Flipped Class Room, Lecture, PPT's, Role play, Assignments Class/Virtual Presentations, Report and beyond the classroom activities			
<b>List of Challenging Experiments (Indicative)</b>		<b>CO:1,2,3,4,5</b>	
1.	Setting short term and long term goals	2 hours	
2.	Mime/Skit/ Activities through VIT Community Radio	6 hours	
3.	Critically evaluate / review a documentary/ Activities through VIT Community Radio	4 hours	
4.	Mini Project	10 hours	
5.	Digital Synopsis	4 hours	
6.	Case analysis of a challenging Scenario	4 hours	
7.	Intensive & Extensive reading of Scientific Texts	4 hours	
8.	Editing any given text	8 hours	
9.	Group discussion on a given topic / Activities through VIT Community Radio	8 hours	
10.	Prepare a video résumé along with your video introduction and then create a website (in Google Sites/Webly/Wix) showcasing skills and achievements.	10 hours	
Total Laboratory Hours		60 hours	
Mode of evaluation: Mini Project, Flipped Class Room, Lecture, PPT's, Role play, Assignments Class/Virtual Presentations, Report and beyond the classroom activities			
Recommended by Board of Studies		22-07-2017	
Approved by Academic Council		No. 47	Date 24.08.2017

Course code	Course title	L	T	P	J	C
<b>FRE5001</b>	<b>Français Fonctionnel</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Pre-requisite</b>		<b>Syllabus version</b>				
		v.1				
<b>Course Objectives:</b>						
The course gives students the necessary background to:						
1. Demonstrate competence in reading, writing, and speaking basic French, including knowledge of vocabulary (related to profession, emotions, food, workplace, sports/hobbies, classroom and family).						
2. Achieve proficiency in French culture oriented view point.						
<b>Expected Course Outcome:</b>						
The students will be able to						
1. Remember the daily life communicative situations via personal pronouns, emphatic pronouns, salutations, negations, interrogations etc.						
2. Create communicative skill effectively in French language via regular / irregular verbs.						
3. Demonstrate comprehension of the spoken / written language in translating simple sentences.						
4. Understand and demonstrate the comprehension of some particular new range of unseen written materials.						
5. Demonstrate a clear understanding of the French culture through the language studied.						
<b>Module:1</b>	Saluer, Se présenter, Etablir des contacts	<b>9 hours</b>				
Les Salutations, Les nombres (1-100), Les jours de la semaine, Les mois de l'année, Les Pronoms Sujets, Les Pronoms Toniques, La conjugaison des verbes réguliers, La conjugaison des verbes irréguliers- avoir / être / aller / venir / faire etc.						
<b>Module:2</b>	<b>Présenter quelqu'un, Chercher un(e) correspondant(e), Demander des nouvelles d'une personne.</b>	<b>9 hours</b>				
La conjugaison des verbes Pronominaux, La Négation, L'interrogation avec 'Est-ce que ou sans Est-ce que'.						
<b>Module:3</b>	<b>Situer un objet ou un lieu, Poser des questions</b>	<b>9 hours</b>				
L'article (défini/ indéfini), Les prépositions (à/en/au/aux/sur/dans/avec etc.), L'article contracté,						

Les heures en français, La Nationalité du Pays, L'adjectif (La Couleur, l'adjectif possessif, l'adjectif démonstratif/ l'adjectif interrogatif (quel/quelles/quelle/quelles), L'accord des adjectifs avec le nom, L'interrogation avec Comment/ Combien / Où etc.,			
<b>Module:4</b>	<b>Faire des achats, Comprendre un texte court, Demander et indiquer le chemin.</b>	<b>8 hours</b>	
La traduction simple :(français-anglais / anglais –français)			
<b>Module:5</b>	<b>Trouver les questions, Répondre aux questions générales en français.</b>	<b>7 hours</b>	
L'article Partitif, Mettez les phrases aux pluriels, Faites une phrase avec les mots donnés, Exprimez les phrases données au Masculin ou Féminin, Associez les phrases.			
<b>Module:6</b>	<b>Comment écrire un passage</b>	<b>9 hours</b>	
<b>Décrivez :</b> La Famille /La Maison, /L'université /Les Loisirs/ La Vie quotidienne etc.			
<b>Module:7</b>	<b>Comment écrire un dialogue</b>	<b>7 hours</b>	
<b>Dialogue:</b> a) Réserver un billet de train b) Entre deux amis qui se rencontrent au café c) Parmi les membres de la famille d) Entre le client et le médecin			
<b>Module:8</b>	<b>Invited Talk: Native speakers</b>	<b>2 hours</b>	
		<b>Total Lecture hours:</b>	<b>30 hours</b>
<b>Text Book(s)</b>			
1.	Echo-1, Méthode de français, J. Girardet, J. Pécheur, Publisher CLE International, Paris 2010.		
2	Echo-1, Cahier d'exercices, J. Girardet, J. Pécheur, Publisher CLE International, Paris 2010.		
<b>Reference Books</b>			
1.	CONNEXIONS 1, Méthode de français, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2004.		
2	CONNEXIONS 1, Le cahier d'exercices, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2004.		
3	ALTER EGO 1, Méthode de français, Annie Berthet, Catherine Hugo, Véronique M. Kizirian, Béatrix Sampsonis, Monique Waendendries , Hachette livre 2006.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT			
Recommended by Board of Studies		26.02.2016	
Approved by Academic Council		No.41	Date 17-06-2016

Course code	Course title	L	T	P	J	C
GER5001	Deutsch für Anfänger	2	0	0	0	2
Pre-requisite	NIL	Syllabus version				
		v.1				
<b>Course Objectives:</b>						
The course gives students the necessary background to:						
1.Enable students to read and communicate in German in their day to day life						
2.Become industry-ready						
3.Make them understand the usage of grammar in the German Language.						
<b>Expected Course Outcome:</b>						
The students will be able to						
1. Create the basics of German language in their day to day life.						
2. Understand the conjugation of different forms of regular/irregular verbs.						
3. Understand the rule to identify the gender of the Nouns and apply articles appropriately.						
4. Apply the German language skill in writing corresponding letters, E-Mails etc.						
5. Create the talent of translating passages from English-German and vice versa and To frame simple dialogues based on given situations.						
<b>Module:1</b>		<b>3 hours</b>				
Einleitung, Begrüßungsformen, Landeskunde, Alphabet, Personalpronomen, Verb Konjugation, Zahlen (1-100), W-fragen, Aussagesätze, Nomen – Singular und Plural						
<b>Lernziel:</b>						
Elementares Verständnis von Deutsch, Genus- Artikelwörter						
<b>Module:2</b>		<b>3 hours</b>				
Konjugation der Verben (regelmässig /unregelmässig) die Monate, die Wochentage, Hobbys, Berufe, Jahreszeiten, Artikel, Zahlen (Hundert bis eine Million), Ja-/Nein- Frage, Imperativ mit Sie						
<b>Lernziel :</b>						
Sätze schreiben, über Hobbys erzählen, über Berufe sprechen usw.						

<b>Module:3</b>		<b>4 hours</b>
Possessivpronomen, Negation, Kasus- Akkusativ und Dativ (bestimmter, unbestimmter Artikel), trennbare Verben, Modalverben, Adjektive, Uhrzeit, Präpositionen, Mahlzeiten, Lebensmittel, Getränke <b>Lernziel :</b> Sätze mit Modalverben, Verwendung von Artikel, über Länder und Sprachen sprechen, über eine Wohnung beschreiben.		
<b>Module:4</b>		<b>6 hours</b>
Übersetzungen : (Deutsch – Englisch / Englisch – Deutsch) <b>Lernziel :</b> Grammatik – Wortschatz - Übung		
<b>Module:5</b>		<b>5 hours</b>
Leseverständnis, Mindmap machen, Korrespondenz- Briefe, Postkarten, E-Mail <b>Lernziel :</b> Wortschatzbildung und aktiver Sprachgebrauch		
<b>Module:6</b>		<b>3 hours</b>
<b>Aufsätze :</b> Meine Universität, Das Essen, mein Freund oder meine Freundin, meine Familie, ein Fest in Deutschland usw		
<b>Module:7</b>		<b>4 hours</b>
<b>Dialoge:</b> a) Gespräche mit Familienmitgliedern, Am Bahnhof, b) Gespräche beim Einkaufen ; in einem Supermarkt ; in einer Buchhandlung ; c) in einem Hotel - an der Rezeption ; ein Termin beim Arzt. Treffen im Cafe		
<b>Module:8</b>		<b>2 hours</b>
Guest Lectures/Native Speakers / Feinheiten der deutschen Sprache, Basisinformation über die deutschsprachigen Länder		
	<b>Total Lecture hours:</b>	<b>30 hours</b>
<b>Text Book(s)</b>		
1.	<b>Studio d A1 Deutsch als Fremdsprache, Hermann Funk, Christina Kuhn, Silke Demme : 2012</b>	
<b>Reference Books</b>		
1	Netzwerk Deutsch als Fremdsprache A1, Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, 2013	
2	Lagune ,Hartmut Aufderstrasse, Jutta Müller, Thomas Storz, 2012.	
3	Deutsche Sprachlehre für Ausländer, Heinz Griesbach, Dora Schulz, 2011	
4	ThemenAktuell 1, Hartmut Aufderstrasse, Heiko Bock, Mechthild Gerdes, Jutta Müller und Helmut Müller, 2010	
	<a href="http://www.goethe.de">www.goethe.de</a> <a href="http://wirtschaftsdeutsch.de">wirtschaftsdeutsch.de</a> <a href="http://hueber.de">hueber.de</a> <a href="http://klett-sprachen.de">klett-sprachen.de</a>	

www.deutschtraning.org			
Mode of Evaluation: CAT / Assignment / Quiz / FAT			
Recommended by Board of Studies	04.03.2016		
Approved by Academic Council	41	Date	17.06.2016

MSM	BIOSTATISTICS	L	T	P	J	C
5001		2	0	2	0	3
Pre-requisite	NIL	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives:</b>						
<ol style="list-style-type: none"> <li>Understand the concepts behind collection and presentation of data</li> <li>Understand the measures of central tendency and dispersion along with related analysis</li> <li>Interpret and analyse data using statistical tools and design experiments</li> </ol>						
<b>Expected Course Outcome:</b>						
<ol style="list-style-type: none"> <li>Construct tables and graphs for data presentation</li> <li>Explain measures of central tendency and dispersion along with predicting probability features of experiments.</li> <li>Discuss the correlation between different types of data along with related variables.</li> <li>Test hypothesis and carry out related statistical tests including that of significance.</li> <li>Formulate designs for experiments.</li> <li>Analyse and interpret practically, the data acquired in biological experiments, by using statistical methods.</li> </ol>						
<b>Module:1</b>	<b>Descriptive methods</b>	<b>5 hours</b>				
Frequency Distribution, Characteristics of a Frequency Distribution, Tabular and Graphical Presentation of Data: Line Graphs, Bar Charts, Histograms						
<b>Module:2</b>	<b>Measures of central tendency</b>	<b>5 hours</b>				
Arithmetic Mean, Median, Mode, Selection of the Appropriate Measure of Central Tendency, Geometric Mean, Harmonic Mean						
<b>Module:3</b>	<b>Measures of dispersion -</b>	<b>3 hours</b>				
Range, quartile Deviation, Mean Deviation, Variance and Standard Deviation, Skewness and Kurtosis.						



<b>Module:4</b>	<b>Probability</b>	<b>3 hours</b>
Probability Definition, Rules for Calculating Probabilities, Normal Distribution.		
<b>Module:5</b>	<b>Correlation and Regression</b>	<b>3 hours</b>
Correlation , Karl Pearson correlation, Rank correlation, regression analysis		
<b>Module:6</b>	<b>Data analysis and interpretation</b>	<b>5 hours</b>
Tests of hypothesis, Tests of significance, student' s t- test, Non-parametric test: chi-square test, Goodness of fit, Analysis of variance. F-test		
<b>Module:7</b>	<b>Experimental Design</b>	<b>3 hours</b>
Designed Experiments - Principles of experimental design, Blocking and Extraneous Variables. Completely Randomized Design, Randomized block design		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>3 hours</b>
Industrial Expert lecture		
<b>Total Lecture hours:</b>		<b>30 hours</b>
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
<b>Text Book(s)</b>		
1.	Wayne W. Daniel, Chad L. Cross, 2012, 10 <sup>th</sup> edition, Biostatistics: A Foundation for Analysis in the Health Sciences, Wiley Sciences Publisher	
<b>Reference Books</b>		
1.	<b>Gupta S.P., 2010, 5<sup>th</sup> Edition, Statistical Methods, Sultan chand &amp; Sons.</b>	
<b>List of Challenging Experiments (Indicative)</b>		
1	Determination of frequency distribution for raw data for population	2 Hours
2	Estimation of mean ,median and mode	2 Hours
3	Estimation of SD	2 Hours
4	Estimation of variability	2 Hours
5	Estimation of correlation coefficient	2 Hours
6	Estimation of regression analysis	2 Hours

7	Hypotesis testing	2 Hours
8	Chi-square test	2 Hours
9	Challenging research problems on t test	2 Hours
10	Challenging research problems on Estimation of one way ANOVA	2 Hours
11	Challenging research problems on Estimation of two way ANOVA	2 Hours
12	Challenging research problems on Designs of experiments	2 Hours
13	Challenging research problems on Determination of frequency distribution for raw data for population	3 Hours
14	Challenging research problems on. Estimation of mean ,median and mode	3 Hours
Total Laboratory Hours		30 Hours
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
Recommended by Board of Studies	03-08-2017	
Approved by Academic Council	No. 46	Date 24-08-2017

<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
<b>STS 4001</b>	<b>Essentials of Business Etiquette and problem solving</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
<b>Pre-requisite</b>	<b>None</b>	<b>Syllabus version</b>				
<b>Course Objectives:</b>						
<ul style="list-style-type: none"> <li>• To develop the students' logical thinking skills</li> <li>• To learn the strategies of solving quantitative ability problems</li> <li>• To enrich the verbal ability of the students</li> <li>• To enhance critical thinking and innovative skills</li> </ul>						
<b>Expected Course Outcome:</b>						
<ul style="list-style-type: none"> <li>• Enabling students to use relevant aptitude and appropriate language to express themselves</li> <li>• To communicate the message to the target audience clearly</li> <li>• The students will be able to be proficient in solving quantitative aptitude and verbal ability questions of various examinations effortlessly</li> </ul>						
<b>Module:1</b>	<b>Business Etiquette: Social and Cultural Etiquette and Writing Company Blogs and Internal Communications and Planning and Writing press release and meeting notes</b>	<b>9 hours</b>				
Value, Manners, Customs, Language, Tradition, Building a blog, Developing brand message, FAQs', Assessing Competition, Open and objective Communication, Two way dialogue, Understanding the audience, Identifying, Gathering Information, Analysis, Determining, selecting plan, Progress check, Types of planning, Write a short, catchy headline, Get to the Point – summarize your subject in the first paragraph., Body – Make it relevant to your audience,						
<b>Module:2</b>	<b>Study skills – Time management skills</b>	<b>3 hours</b>				
Prioritization, Procrastination, Scheduling, Multitasking, Monitoring, working under pressure and adhering to deadlines						

<b>Module:3</b>	<b>Presentation skills – Preparing presentation and Organizing materials and Maintaining and preparing visual aids and Dealing with questions</b>	<b>7 hours</b>
10 Tips to prepare PowerPoint presentation, Outlining the content, Passing the Elevator Test, Blue sky thinking, Introduction , body and conclusion, Use of Font, Use of Color, Strategic presentation, Importance and types of visual aids, Animation to captivate your audience, Design of posters, Setting out the ground rules, Dealing with interruptions, Staying in control of the questions, Handling difficult questions		
<b>Module:4</b>	<b>Quantitative Ability -L1 – Number properties and Averages and Progressions and Percentages and Ratios</b>	<b>11 hours</b>
Number of factors, Factorials, Remainder Theorem, Unit digit position, Tens digit position, Averages, Weighted Average, Arithmetic Progression, Geometric Progression, Harmonic Progression, Increase & Decrease or successive increase, Types of ratios and proportions		
<b>Module:5</b>	<b>Reasoning Ability-L1 – Analytical Reasoning</b>	<b>8 hours</b>
Data Arrangement (Linear and circular & Cross Variable Relationship), Blood Relations, Ordering/ranking/grouping, Puzzle test, Selection Decision table		
<b>Module:6</b>	<b>Verbal Ability-L1 – Vocabulary Building</b>	<b>7 hours</b>
Synonyms & Antonyms, One-word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies		
	<b>Total Lecture hours:</b>	<b>45 hours</b>
<b>Reference Books</b>		
1.	Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler (2001) Crucial Conversations: Tools for Talking When Stakes are High. Bangalore. McGraw-Hill Contemporary	
2.	Dale Carnegie, (1936) How to Win Friends and Influence People. New York. Gallery Books	
3.	Scott Peck. M (1978) Road Less Travelled. New York City. M. Scott Peck.	
4.	FACE (2016) Aptipedia Aptitude Encyclopedia. Delhi. Wiley publications	
5.	ETHNUS (2013) Aptimithra. Bangalore. McGraw-Hill Education Pvt. Ltd.	
<b>Websites:</b>		
1.	<a href="http://www.chalkstreet.com">www.chalkstreet.com</a>	
2.	<a href="http://www.skillsyouneed.com">www.skillsyouneed.com</a>	
3.	<a href="http://www.mindtools.com">www.mindtools.com</a>	

4.	<a href="http://www.thebalance.com">www.thebalance.com</a>
5.	<a href="http://www.eguru.000">www.eguru.000</a>
<b>Mode of Evaluation:</b> FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)	

Course code	Course title	L	T	P	J	C
STS 4002	Preparing for Industry	3	0	0	0	1
Pre-requisite	None	Syllabus version				
		1				
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>To challenge students to explore their problem-solving skills</li> <li>To develop essential skills to tackle advance quantitative and verbal ability questions</li> <li>To have working knowledge of communicating in English</li> </ul>					
<b>Expected Course Outcome:</b>	<ul style="list-style-type: none"> <li>Enabling students to simplify, evaluate, analyze and use functions and expressions to simulate real situations to be industry ready.</li> <li>The students will be able to interact confidently and use decision making models effectively</li> <li>The students will be able to be proficient in solving quantitative aptitude and verbal ability questions of various examinations effortlessly</li> </ul>					
<b>Module:1</b>	<b>Interview skills – Types of interview and Techniques to face remote interviews and Mock Interview</b>	<b>3 hours</b>				
Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers' perspective, Questions to ask/not ask during an interview, Video interview, Recorded feedback, Phone interview preparation, Tips to customize preparation for personal interview, Practice rounds						
<b>Module:2</b>	<b>Resume skills – Resume Template and Use of power verbs and Types of resume and Customizing resume</b>	<b>2 hours</b>				
Structure of a standard resume, Content, color, font, Introduction to Power verbs and Write up, Quiz on types of resume, Frequent mistakes in customizing resume, Layout - Understanding different company's requirement, Digitizing career portfolio						

<b>Module:3</b>	<b>Emotional Intelligence - L1 – Transactional Analysis and Brain storming and Psychometric Analysis and Rebus Puzzles/Problem Solving</b>	<b>12 hours</b>
Introduction, Contracting, ego states, Life positions, Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlette procedure, Round robin brainstorming, Skill Test, Personality Test, More than one answer, Unique ways		
<b>Module:4</b>	<b>Quantitative Ability-L3 – Permutation-Combinations and Probability and Geometry and mensuration and Trigonometry and Logarithms and Functions and Quadratic Equations and Set Theory</b>	<b>14 hours</b>
Counting, Grouping, Linear Arrangement, Circular Arrangements, Conditional Probability, Independent and Dependent Events, Properties of Polygon, 2D & 3D Figures, Area & Volumes, Heights and distances, Simple trigonometric functions, Introduction to logarithms, Basic rules of logarithms, Introduction to functions, Basic rules of functions, Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations, Basic concepts of Venn Diagram		
<b>Module:5</b>	<b>Reasoning ability-L3 – Logical reasoning and Data Analysis and Interpretation</b>	<b>7 hours</b>
Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic, Data Sufficiency, Data interpretation-Advanced, Interpretation tables, pie charts & bar chats		
<b>Module:6</b>	<b>Verbal Ability-L3 – Comprehension and Logic</b>	<b>7 hours</b>
Reading comprehension, Para Jumbles, Critical Reasoning (a) Premise and Conclusion, (b) Assumption & Inference, (c) Strengthening & Weakening an Argument		
	<b>Total Lecture hours:</b>	<b>45 hours</b>
<b>References</b>	<ul style="list-style-type: none"> <li>• Michael Farra and JIST Editors(2011) Quick Resume &amp; Cover Letter Book: Write and Use an Effective Resume in Just One Day. Saint Paul, Minnesota. Jist Works</li> <li>• Daniel Flage Ph.D(2003) The Art of Questioning: An Introduction to Critical Thinking. London. Pearson</li> <li>• FACE(2016) Aptipedia Aptitude Encyclopedia.Delhi. Wiley publications</li> </ul>	
<b>Mode of Evaluation:</b> FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)		

<b>RES5001</b>	<b>Research Methodology</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Syllabus version</b>				
		v. 1.0				
<b>Course Objectives:</b>						
<ol style="list-style-type: none"> <li>1. Impart skills to develop a research topic and design</li> <li>2. Define a purpose statement, a research question or hypothesis, and a research objective</li> <li>3. Analyze the data and arrive at a valid conclusion</li> <li>4. Compile and present research findings</li> </ol>						
<b>Expected Course Outcome:</b>						
<ol style="list-style-type: none"> <li>1. Explain the basic aspects of research and its ethics</li> <li>2. Outline research problems, their types and objectives</li> <li>3. Formulate good research designs and carry out statistically relevant sampling</li> <li>4. Collect, collate, analyze and interpret data systematically.</li> <li>5. Experiment with animals ethically</li> <li>6. Make use of literature and other search engines judiciously for research purposes</li> </ol>						
<b>Module:1</b>	<b>Introduction and Foundation of Research</b>	<b>2 hours</b>				
Meaning, Objectives, Motivation, Utility for research. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method –Understanding the language of research.						
<b>Module:2</b>	<b>Problem identification and formulation</b>	<b>4 hours</b>				
Scientific Research: Problem, Definition, Objectives, Types, Purposes and components of Research problem						

<b>Module:3</b>	<b>Research Design</b>	<b>4 hours</b>
Concept and Importance in Research : Features of a good research design, Exploratory Research Design and Descriptive Research Designs		
<b>Module:4</b>	<b>Sampling</b>	<b>6 hours</b>
Sampling methods, Merits and Demerits. Observation methods, Sampling Errors (Type I and Type II). Determining size of the sample. Experimental Design: Concept of Independent & Dependent variables.		
<b>Module:5</b>	<b>Data analysis and Reporting</b>	<b>6 hours</b>
Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression; Research Reports: Structure, Components, Types and Layout of Research report and articles, Writing and interpreting research results, Figures and Graphs		
<b>Module:6</b>	<b>Animal handling</b>	<b>2 hours</b>
guidelines-animal ethical committee, animal models, various routes of drug administrations, LD <sub>50</sub> , ED <sub>50</sub>		
<b>Module:7</b>	<b>Use of encyclopedias and tools in research</b>	<b>4 hours</b>
Research Guides, Handbook, Academic Databases for Biological Science Discipline.		
Methods to search required information effectively.		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
<b>Total Lecture hours:</b>		<b>30 hours</b>
<b>Text Book(s)</b>		
1.	Catherine Dawson, Introduction to research methods : a practical guide for anyone undertaking a research project, Oxford : How To Books, Reprint 2010	
2.	Julius S. Bendat, Allan G. Piersol, Random Data: Analysis and Measurement Procedures, 4th Edition, ISBN: 978-1-118-21082-6, 640 pages, September 2011	
3.	Research in Medical and Biological Sciences, 1st Edition, From Planning and Preparation to Grant Application and Publication, Editos: Petter Laake Haakon Benestad Bjorn Olsen, ISBN: 9780128001547, Academic Press, March 2015	
<b>Reference Books</b>		
1.	John Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, Fourth Edition (March 14, 2013)	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
Recommended by Board of Studies	03.08.2017	
Approved by Academic Council	No.46	Date 24-08-2017



<b>Course Code</b>	<b>Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
<b>MSM6099</b>	<b>Master's Thesis</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>14</b>
<b>Pre-requisite</b>	<b>As per the academic regulations</b>	<b>Syllabus version</b>				
		<b>1.0</b>				
<b>Course Objectives:</b>						
To provide sufficient hands-on learning experience related to the area of specialization with a focus on research orientation						
<b>Expected Course Outcome:</b>						
<ol style="list-style-type: none"> <li>1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.</li> <li>2. Perform literature search and / or patent search in the area of interest.</li> <li>3. Design and Conduct experiments</li> <li>4. Perform error analysis / benchmarking / costing</li> <li>5. Synthesise the results and arrive at scientific conclusions</li> <li>6. Document the results in the form of technical report / presentation</li> </ol>						
<b>Contents</b>						
<ol style="list-style-type: none"> <li>1. Can be a theoretical analysis, modeling &amp; simulation, experimentation &amp; analysis, prototype design, correlation and analysis of data, software development, applied research and any other related activities.</li> <li>2. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.</li> <li>3. Should be individual work.</li> <li>4. Carried out inside or outside the university, in any relevant industry or research institution.</li> </ol>						

5. Publications in the peer reviewed journals / International Conferences will be an added advantage			
<b>Mode of Evaluation:</b> Periodic reviews, Presentation, Final oral viva, Poster submission			
Recommended by Board of Studies	04.03.2016		
Approved by Academic Council	40 <sup>th</sup> AC	Date	18.03.2016

Course Code	Title	L	T	P	J	C
<b>BMG5001</b>	<b>BIOCHEMISTRY</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>4</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
		1.1				
<b>Course objectives (CoB):</b>						
1. Able to demonstrate fundamental biochemical principles, such as the structure/function of biomolecules and the regulation of biological/biochemical processes						
2. Define the major pathways of intermediary metabolism of biomolecules, and discuss their bioenergetics, physiological adaptation, metabolic and main hormonal regulation, localization and cellular compartmentalization.						
3. Correlate the metabolic activity of molecules with their function						
<b>Expected Course Outcomes (CO):</b>						
1. Demonstrate an understanding of the chemistry, structure and function of biological molecules						
2. Explain biological mechanisms, such as the processes and control of bioenergetics and metabolism, as chemical reactions						
3. Solve the biochemical processes that underlie the relationship between proteins and other macromolecules						
4. Discuss how disruptions in intermediary metabolism may lead to disease, and illustrate with selected examples						
5. Build an ability to employ critical thinking and scientific inquiry						
6. Demonstrate critical thinking skills to solve problems relating to chemistry and/or Biochemistry						
<b>Module:1</b>	<b>Carbohydrates</b>	<b>6 hours</b>				
Classification, structure, properties and function; Aminoacids -classification, structure and function. Abnormalities of carbohydrate metabolism						
<b>Module:2</b>	<b>Proteins</b>	<b>6 hours</b>				

Classification, Structure, properties and function; Protein metabolism, Higher orders of structure; Myoglobin and Hemoglobin		
<b>Module:3</b>	<b>Lipids</b>	<b>6 hours</b>
Classification, structure and function; Fatty acid biosynthesis, oxidation, cholesterol biosynthesis Nucleotides–classification, structure and function		
<b>Module:4</b>	<b>Catabolism of carbohydrates</b>	<b>7 hours</b>
Glycolysis, TCA cycle Oxidative phosphorylation, HMP-shunt, gluconeogenesis. glycogenesis, Glycogenolysis		
<b>Module:5</b>	<b>Aminoacid metabolism</b>	<b>6 hours</b>
Essential aminoacid, sources, Biosynthesis of nonessential amino acids, Urea cycle		
<b>Module:6</b>	<b>Metabolism of purines and pyrimidines</b>	<b>6 hours</b>
<i>De novo</i> and salvage pathway of biosynthesis and break down of purines and pyrimidines.		
<b>Module:7</b>	<b>Energy metabolism</b>	<b>6 hours</b>
Biological oxidation, high energy compounds, electron transport chain and oxidative phosphorylation.		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
Industry expert lecture		
<b>Total Lecture hours:</b>		<b>45 hours</b>
<b>Mode of Evaluation:</b> Digital Assignments, Continuous Assessment Tests and Final assessment test.		
<b>Text Book(s)</b>		
1.	Nelson, D.L. and M.M.Cox.. Lehninger's Principles of Biochemistry, 2011, Sixth Edition, WH Freeman, New York.	
2.	Victor W. Rodwell (Author), David Bender (Author), Kathleen M. Botham (Author), Peter J. Kennelly. 2011. Harpers Illustrated Biochemistry, 30th Edition, McGraw-Hill companies, Inc. USA	
<b>Reference Books</b>		
1.	Christopher K. Mathews (Author), Kensal E. Van Holde (Author), Dean R. Appling (Author), Spencer J. Anthony-Cahill (Author). 2012. Biochemistry, 4th Edition. Prentice	
<b>List of Challenging Experiments</b>		
1.	Estimation of blood glucose	2 Hours
2.	Estimation of blood cholesterol	2 Hours
3.	Estimation of uric acid in blood	2 Hours
4.	Estimation of Urea	4 Hours
5.	Estimation of serum total protein	4 Hours
6	Estimation of DNA	2 Hours
7	Leukocyte isolation from peripheral blood	2 Hours

8	Estimation of Arylsulphatase activity from the isolated leukocytes	4 Hours
9	Isolation of Glycosaminoglycans (GAGs) from Urine.	4 Hours
10	Thin layer chromatography of the isolated GAG	4 Hours
<b>Total Laboratory Hours</b>		<b>30 hours</b>
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
Recommended by Board of Studies	03-08-2017	
Approved by Academic Council	No. 46	Date 24-08-2017

Course code	Course title	L	T	P	J	C
<b>BMG5002</b>	<b>PRINCIPLES OF GENETICS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
						1.1
<b>Course Objectives (CoB):</b>						
The course is aimed						
1. To compare the fundamental principles of classical and molecular genetics.						
2. To summarize the basics of Mendelian and molecular genetics.						
3. To interpret the basic mathematical principles relevant to genetics.						
<b>Expected Course Outcome (CO):</b>						
1. Apply the knowledge to learn the concepts of genetics at the molecular, microbial and societal level.						
2. Summarize the different heredity patterns and family history importance for heredity risks.						
3. Outline the genomic structure, how DNA, genes, and chromosomes are related to one another and how genetic changes are connected to genetic diseases.						
4. Compare the relationship between phenotype and genotype in human genetic traits.						
5. Make use of the scientific method to generate new knowledge and to solve problems, regarding human heredity.						
6. Relate real-life situations and one's life the principles of human heredity						
<b>Module:1</b>	<b>Mendelian Genetics</b>	<b>9 hours</b>				
Mendel's experiments, monohybrid and dihybrid crosses, back cross, test cross, genetic ratios, Molecular basis of Mendelian genetics, Mendelian Inheritance, Law of Segregation, Independent Assortment. Epistasis, Incomplete dominance, Multiple alleles, Lethal genes.						
<b>Module:2</b>	<b>Non-Mendelian inheritance</b>	<b>4 hours</b>				

Patterns of Inheritance- Non-Mendelian inheritance. Human Genetics - Inheritance patterns and Pedigrees. Pedigree symbols and analysis.

<b>Module:3</b>	<b>Genome Organization</b>	<b>8 hours</b>
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Eukaryotic genome structure and function – Chromosomal theory, the topography of the chromosomes set, Chromosome number, size, centromeres, the position of nucleolar organizers. Heterochromatin patterns, the 3-D structure of the chromosome, role of histone protein in packaging sequence, organization, repetitive sequences. Mitosis and Meiosis, Comparison with the prokaryotic genome.

<b>Module:4</b>	<b>Linkage and Mapping</b>	<b>6 hours</b>
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Linkage and chromosome mapping: Linkage and recombination, linkage maps, linkage mapping with molecular markers. DNA testing, DNA tests for identity and relationships including forensic applications.

<b>Module:5</b>	<b>Microbial Genetics</b>	<b>4 hours</b>
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DNA as a genetic material – experiments of Griffith, Hershey, Chase, and McLeod. Gene transfer in Bacteria, Bacterial conjugation – fertility factor, HFR strain, interrupted mating experiments.

<b>Module:6</b>	<b>Molecular mechanism of bacterial gene mapping</b>	<b>4 hours</b>
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Transformation. Transduction – specialized transduction, generalized transduction and chromosome mapping.

<b>Module:7</b>	<b>Population Genetics and Behavioural Genetics</b>	<b>8 hours</b>
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Hardy – Weinberg law, Factors affecting Hardy-Weinberg law: mutation, recombination, migration, assortative mating, and selection. Non-random mating in the human population, inbreeding coefficient. Behavioural Genetics- Behaviour and genome, Genes and criminality, Intelligence, genes and the environment. Molecular research in intelligence.

<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
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Lecture by Industrial Expert

	<b>Total Lecture hours:</b>	<b>45 hours</b>
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Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

**Text Book(s)**

1. Griffiths AJF, Wessler SR, Lewontin RC and Carroll SB (2015). An Introduction to genetic analysis. 11<sup>th</sup> ed. W.H Freeman.

**Reference Books**

1. David L. Rimoin, Reed E. Pyeritz, Bruce Korf (2013). Emery and Rimoin's Essential Medical Genetics. Elsevier
2. Hartl, D.L. et al. (2012). Genetics: Analysis of Genes and Genomes, 8th ed., Jones and Bartlett Publishers.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	03-08-2017
Approved by Academic Council	No. 46
Date	24-08-2017

<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
<b>BMG5003</b>	<b>HUMAN IMMUNOLOGY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
<ol style="list-style-type: none"> <li>1. Differentiate the function the various cells and tissues of the human immune system.</li> <li>2. Compare the physiological and pathological functions of the immune system in disease and organ transplantation.</li> <li>3. Evaluate how the components of immune system work together to achieve a state of health and well being</li> </ol>						
<b>Expected Course Outcome (CO):</b>						
<ol style="list-style-type: none"> <li>1. Explain the foundation of the defense mechanisms of the human body.</li> <li>2. Distinguish various cell types involved in immune responses and their associated functions.</li> <li>3. Describe and discuss the basis of complex genetic events that contribute to immunological responses</li> <li>4. Interpret and examine the pathobiology of infections, and the interaction of pathogens with the immune system</li> <li>5. Demonstrate a comprehensive understanding of basic immunological principles involved in host graft compatibility and other immune disorders.</li> <li>6. Translate the basic knowledge of the immune system to further appraise and develop understanding of medicine (vaccines) and related research topics in human immunology.</li> </ol>						
<b>Module: 1</b>	<b>Introduction to Immunology</b>	<b>6 hours</b>				
Overview of Immune system. Cells and organs of the immune system. Basic Principles of Immunity,						

Immunogens and antigens, Immunoglobulin classes, structure and function.		
<b>Module: 2</b>	<b>Organization and expression of Immunoglobulin genes</b>	<b>6 hours</b>
Multigene organization of immunoglobulin genes, variable and constant region genes, generating antibody diversity, class switching among constant region genes.		
<b>Module: 3</b>	<b>General organization and inheritance of MHC</b>	<b>6 hours</b>
MHC molecules and genes, cellular distribution of MHC, regulation of MHC expression.		
<b>Module: 4</b>	<b>Immunohaematology &amp; Immunity in Health &amp; Disease</b>	<b>8 hours</b>
Blood group system; ABO blood groups, Genetics of ABO blood groups and Rh factor, Rh Incompatibility. Immune response to infectious diseases, AIDS and other Immunodeficiencies. Primary and secondary deficiencies, Inherited Immunodeficiency diseases.		
<b>Module: 5</b>	<b>Transplantation</b>	<b>6 hours</b>
Types of grafts, Immunological basis of graft rejection, Clinical manifestation of graft rejection, graft versus host reaction.		
<b>Module:6</b>	<b>Hypersensitivity</b>	<b>6 hours</b>
Overview and Types. <b>Autoimmunity</b> -Organ specific and systemic autoimmune diseases. <b>Tumor Immunology</b> - Tumor antigens, immune response to tumor antigens and tumor immunotherapy.		
<b>Module:7</b>	<b>Vaccines</b>	<b>5 hours</b>
Vaccine types, recent developments in vaccine production, vaccine failures, challenges in vaccine production. Human monoclonal antibodies, Monoclonal antibodies production and their applications.		
<b>Module: 8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
Latest advances in immunology. (By Industry experts).		
<b>Total Lecture hours:</b>		<b>45 hours</b>
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
<b>Text Book(s)</b>		
1	Abbas, Abul K., Andrew Lichtman and Pillai. Cellular and Molecular Immunology.2014, 8 <sup>th</sup> ed. Philadelphia, PA: Saunders,. ISBN: 978032322275	
2	Peter Parham. The Immune System. 4th Ed Garland Science. Taylor and Francis. 2014.	

ISBN 9780815345275			
<b>Reference Books</b>			
1	Lauren Sompayrac. How the Immune System Works, 5 <sup>th</sup> Edition, Wiley Blackwell, 2016, ISBN-13:978-1118997772.		
2	Kenneth Murphy. Janeway's Immunobiology. 8 <sup>th</sup> New York, Garland Science, 2011. ISBN: 9780815342434		
<b>Mode of Evaluation:</b> CAT / FAT / Assignment			
<b>Recommended by Board of Studies</b> 03-08-2017			
Approved by Academic Council	No. 46	Date	24-08-2017

Course code	Course title	L	T	P	J	C
<b>BMG 6002</b>	<b>CLINICAL CYTOGENETICS AND PRENATAL DIAGNOSIS</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>4</b>
<b>Pre-requisite</b>	<b>Principles of Genetics</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives:</b>						
1. To analyze the cause of human genetic disorders using different cytogenetic techniques. 2. To illustrate the importance of prenatal diagnosis and genetic testing. 3. To elaborate on the ethical issues in clinical genetics research and genetic counseling						
<b>Expected Course Outcome:</b>						
1. Have knowledge on the application of the cytogenetic techniques for clinical classification of the genetic disorders. 2. Analyze the cause of genetic disorders. 3. Relate the importance of new genetics with clinical practice 4. Translate various aspects of genetic knowledge to society. 5. Design /develop an idea for identifying the cause or solution for the genetic disorder 6. Identify the cause and interpret the clinical conditions						
<b>Module:1</b>	<b>Cytogenetics Technology and Nomenclature</b>	<b>5 hours</b>				
An international system for human cytogenetic nomenclature, cytogenetic technology, Differential and selective banding techniques, high-resolution banding. Chromosome mapping - somatic cell hybridization, FISH technique, and its clinical application. The techniques: CGH, CGH array, M- FISH and their applications. Microscopy (Light, TEM, SEM) and imaging, computer-assisted image processing systems, flow cytometer, PCC.						



<b>Module:2</b>	<b>Aneuploidy in Human</b>	<b>4 hours</b>
Abnormalities of Chromosome Number- polyploidy, aneuploidy. Clinical cases of Aneuploidy – Autosomal aneuploid syndromes- trisomy 21, trisomy 18, trisomy 13. Sex chromosome aneuploid syndromes- Turner, Klinefelter, Triple X, XYY. Factors causing aneuploidy, non-disjunction, X inactivation.		
<b>Module:3</b>	<b>Structural chromosomal aberrations in Human</b>	<b>5 hours</b>
Types of structural chromosomal aberrations - Duplication, deletion, translocation, reciprocal translocation, Robertsonian translocation, microdeletion, ring chromosome, inversion, isochromosome. Clinical cases.		
<b>Module:4</b>	<b>Genomic Imprinting</b>	<b>4 hours</b>
The imprinting phenomenon and its genetic syndromes. Uniparental disomy (UPD).		
<b>Module:5</b>	<b>Prenatal diagnosis</b>	<b>4 hours</b>
Chromosome Abnormalities and Pregnancy Loss, prenatal diagnosis techniques - amniocentesis, chorionic villus sampling, cordocentesis. Non-invasive techniques. Preimplantation genetic diagnosis and in vitro fertilization		
<b>Module:6</b>	<b>Genetic counseling</b>	<b>3 hours</b>
Population screening, carrier detection and genetic counseling. Types of Genetic counseling, Genetic testing, consanguinity in the human population.		
<b>Module:7</b>	<b>Genetics and Society, Ethical issues in Genetic research</b>	<b>3 hours</b>
Future of genetics: Science & society. Ethical issues and related problems. The application of new genetics to clinical practice, Bioethics and human population genetic research, Reproductive rights		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
Industry expert lecture		
<b>Total Lecture hours:</b>		<b>30 hours</b>
<b>Text Book(s)</b>		
1.	Lynn Jorde, John Carey, and Michael Bamshad (2015) Medical Genetics, 5th Edition, Elsevier	
<b>Reference Books</b>		
1.	David L. Rimoin, Reed E. Pyeritz, Bruce Korf (2013). Emery and Rimoin's Essential Medical Genetics Elsevier	
2.	Emery, A.E.H. and Rimoin, D.L. (2010). Principles and Practices of Medical Genetics. Churchill Livingstone.	
3.	Peter Turnpenny, and Sian Ellard (2010) Emery's Elements of Medical Genetics, 14th edition ISBN 0702029173 / 9780702029172 Churchill Livingstone.	
4.	ICMR Guidelines-Ethics, Prenatal diagnosis	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		

<b>List of Challenging Experiments (Indicative)</b>			
1.	Laboratory Safety and Microscopy for Cytogenetic study.		2 hours
2.	Human Leukocyte Culture.		4 hours
3.	Chromosomes staining and identification.		4 hours
4.	Human chromosome karyotyping.		4 hours
5.	Different Banding Techniques		4 hours
6.	Pedigree Analysis.		4 hours
7.	Use of Karyotyping software.		4 hours
8.	Cytogenetic test report		4 hours
<b>Total Laboratory Hours</b>			30 hours
<b>Mode of Evaluation:</b> CAT / FAT / Assignment			
Recommended by Board of Studies		03-08-2017	
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<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
<b>BMG 5004</b>	<b>HUMAN MOLECULAR GENETICS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives:</b>						
<ol style="list-style-type: none"> <li>1. The objective of this course is to introduce the graduates of biological sciences to the principle of molecular genetics and its application in medicine.</li> <li>2. Familiarization of students with the experimental approaches used in molecular biology.</li> <li>3. The student will acquire knowledge, how natural polymorphism and genetic variation can give rise to mutant genes and how these genetic errors are inherited.</li> </ol>						
<b>Expected Course Outcome:</b>						
<ol style="list-style-type: none"> <li>1. Apply logical analysis in the assessment of relationship between the human molecular genetics and modern medicine.</li> <li>2. Attain a basic conceptual knowledge how gene expression is regulated at different levels, how tissue-specific expression is achieved and exemplify how gene expression can be manipulated and studied experimentally</li> <li>3. Explain concepts such as gene control element and DNA repair defects.</li> <li>4. Will be able to critically think, analyse and evaluate issues related to molecular genetics</li> </ol>						

5. Describe the importance of recent discoveries and the applications and potential of molecular biology associated with these new technologies.
6. Apply the principles and techniques of molecular biology which prepares students for further education and/or employment in teaching and basic research.

<b>Module:1</b>	<b>General organization of the human genome</b>	<b>7 hours</b>
Organization of nuclear and mitochondrial genomes; Distribution of human genes - Coding and Non coding genes. Repetitive DNA with special reference to satellite DNAs and interspersed repeated DNAs, Transposable elements, LINES, SINES, Alu family and their importance in human genome		
<b>Module:2</b>	<b>Transcription</b>	<b>4 hours</b>
Initiation, regulation of initiation, elongation and termination, post transcriptional modification.		
<b>Module:3</b>	<b>Translation</b>	<b>5 hours</b>
Amino acid activation, mechanism of initiation, elongation, termination and post translation Modification		
<b>Module:4</b>	<b>Control of gene expression in human cells</b>	<b>6 hours</b>
Control of gene expression by binding of trans-acting protein factors to cis-acting regulatory sequences in DNA and RNA. DNA repair mechanism. DNA repair defects and the underlying diseases		
<b>Module:5</b>	<b>Dynamics of Repeat sequences</b>	<b>7 hours</b>
Genetic mechanisms which results in sequence exchanges between repeats. Pathogenic mutations, the pathogenic potential of repeated sequences. Simple mutation, Gain of function (GOFA) and loss of function mutation (LOFA) and their association with different inherited human disorder		
<b>Module:6</b>	<b>Genes and diseases</b>	<b>6 hours</b>
Principles and strategies in identifying disease genes, position- independent strategies for identifying disease genes, positional cloning. Applications of mapping in normal and disease genome analysis		
<b>Module:7</b>	<b>Human genome project</b>	<b>8 hours</b>
The ground – breaking importance of genome projects. Background and organization of the Human Genome Project, how the human genome was mapped and sequenced. Advances in sequencing technology, Genetic mapping: Linkage analysis (RFLP/MS/SNP); Applications of mapping in normal and disease genome analysis.		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
Expert lectures from Industry or Hospitals		
	<b>Total Lecture hours:</b>	<b>45 hours</b>

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
<b>Text Book(s)</b>			
1.	Tom Strachan and Andrew P. Read. John, Human Molecular Genetics, 2010, 4 <sup>th</sup> Edition. Garland Publishing London and New York		
<b>Reference Books</b>			
1.	T A Brown , Introduction to Genetics: A Molecular Approach, 2012, Garland Science publisher		
2.	Tom Trachan, Human Molecular Genetics by , Andrew Read , (2010), 4 <sup>th</sup> edition, Garland and Science publisher		
<b>Mode of Evaluation:</b> CAT / FAT / Assignment			
Recommended by Board of Studies		03-08-2017	
Approved by Academic Council		No. 46	Date 24-08-2017

Course code	Course title	L	T	P	J	C
<b>BMG5007</b>	<b>DEVELOPMENTAL GENETICS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
						1.1
<b>Course Objectives (CoB):</b>						
<ol style="list-style-type: none"> <li>1. This advanced course concerns the genes and mechanisms responsible for building multicellular organisms.</li> <li>2. To impart knowledge regarding basic concepts of differentiation and growth, differential gene expression as well as cytoplasmic determinants to the students.</li> <li>3. To introduce students to the developmental processes that lead to the establishment of the body plan of vertebrates and the corresponding cellular and genetic mechanisms.</li> </ol>						
<b>Expected Course Outcome (CO):</b>						
<b>At the end of the course the student should be able to</b>						
<ol style="list-style-type: none"> <li>1. Discuss the critical contributions of the sperm and the egg to the zygote, and how structure informs function.</li> <li>2. Apply critical thinking and logical analysis in assessment of embryonic developmental events including fate map, germ layers development, extra-embryonic membranes, embryo implantation and significance of placental formation</li> <li>3. Attain a basic conceptual knowledge how gene expression is regulated at different levels, how tissue-specific expression is achieved and exemplify how gene expression can be manipulated and studied experimentally</li> <li>4. Describe experiments that would help to distinguish between when a cell has become specified</li> </ol>						

and when its fate has become determined.		
5. Explain and compare different principles of sex determination occurs during embryo development and		
6. Students aware about modern implications of developmental biology by impaired knowledge regarding teratogens.		
<b>Module:1</b>	<b>Germ line</b>	<b>5 hours</b>
Germ plasm and determination of the primordial germ cells, Germ cell migration, Structure of the Gametes.		
<b>Module:2</b>	<b>Early embryonic development</b>	<b>6 hours</b>
Recognition of egg and sperm, Gamete fusion and the prevention of polyspermy, Activation of egg metabolism, Fusion of the genetic material		
<b>Module:3</b>	<b>Cleavage and Gastrulation</b>	<b>5 hours</b>
Patterns of embryonic cleavage, Cleavage and gastrulation in amphibians. Cleavage and gastrulation in humans, molecular mechanism of cleavage.		
<b>Module:4</b>	<b>The genetic core of development</b>	<b>7 hours</b>
Differential gene transcription, methylation pattern and the control of transcription. Transcriptional regulation of an entire chromosome: Dosage compensation. Differential RNA processing, control of gene expression at the level of translation.		
<b>Module:5</b>	<b>The genetics of axis specification in Drosophila</b>	<b>6 hours</b>
Embryogenesis in Drosophila, Early Drosophila development, genes involved in origins of anterior- posterior polarity and dorsal-ventral polarity.		
<b>Module:6</b>	<b>Cell differentiation and late embryonic development</b>	<b>8 hours</b>
Basic principles – Cell fate, fate map, developmental hierarchy, autonomous, conditional and syncytial specification. Mechanisms of cellular determination (endocrine, paracrine, juxtacrine), Neurulation, Myogenesis and tetrapod limb development		
<b>Module:7</b>	<b>Sex determination, Environmental regulation of animal development</b>	<b>6 hours</b>
Chromosomal sex determination in mammals, Chromosomal Sex determination in Drosophila, Environmental sex determination. Environmental regulation of normal development, Environmental disruption of normal development.		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
Expert Lecture from industry or hospitals		
<b>Total Lecture hours:</b>		<b>45 hours</b>
<b>Text Book(s)</b>		
1.	Scott F.Gilbert (2013) Developmental Biology, 10 <sup>th</sup> edition, Sinauer Associates, Inc, Publishers.	
<b>Reference Books</b>		
1.	Lewis Wolpert, Cheryll Tickle, Alfonso Martinez Arias, Principles of Development , 2015, 5 <sup>th</sup> edition, Oxford University Press.	

2.	Jonathan M. W. Slack , Essential Developmental Biology, 2012, 3rd Edition, Wiley-Blackwell publisher.		
3.	Sally Moody , Principles of Developmental Genetics , 2014. 2nd Edition, Academic Press		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		03-08-2017	
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Course code	Course title	L	T	P	J	C
<b>BMG 5008</b>	<b>CANCER GENETICS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
1. To outline the genetic basic of cancer 2. To explain the mechanism of carcinogenesis and metastatic process 3. To define the genetic instability, involvement of cancer stem cells and treatment strategies for cancer						
<b>Expected Course Outcome (CO):</b>						
1. Summarize the molecular basis of cancer 2. Relate the oncogene activation, tumor suppressor gene inactivation and cell cycle dysregulation in carcinogenesis 3. Discuss how the cancer cells evade apoptosis 4. Extend their knowledge in signaling pathways, angiogenesis and metastasis processes 5. Explain the stem cell theory of cancer, origin of cancer stem cells 6. Relate the signaling pathways with the diagnostic methods and treatment approaches for cancer						
<b>Module:1</b>	<b>Hall marks of cancer</b>	<b>6 hours</b>		<b>CO: 1</b>		
Cancer gene theory- activation and suppression, cancer and mutagenesis. Causes for onset of genetic variation and cancer genes and alterations. Viruses (as causative agents).						

<b>Module:2</b>	<b>Oncogene activation, Tumour suppressor gene inactivation and Cell cycle Dysregulation</b>	<b>6 hours</b>	<b>CO: 2</b>
Activated oncogene, Tumour suppressor gene inactivation and cancer gene pathways. Cell cycle dysregulation – Cancer gene pathways converge on cell cycle regulators, Cyclins and cyclin-dependent kinases; Cell Cycle Checkpoints (deficient)			
<b>Module:3</b>	<b>Evading Apoptosis and Telomere dysregulation</b>	<b>6 hours</b>	<b>CO: 3</b>
Inactivation of apoptotic pathways, caspases Bcl-2 Protein Family; IAPs; Endogenous inhibitors of IAPs. Telomeres, Hayflick limit, Telomerase Activation and Immortality, Alternative Lengthening of Telomere (ALT) pathway in cancer.			
<b>Module:4</b>	<b>Angiogenesis and Metastasis</b>	<b>6 hours</b>	<b>CO: 4</b>
Angiogenesis – Angiogenesis, mechanism and role in tumour; Metastasis – Overview of metastasis – Seed and soil theory and beyond; epithelial to mesenchymal transition, signalling pathways in metastasis.			
<b>Module:5</b>	<b>Genetic Instability and cancer</b>	<b>6 hours</b>	<b>CO: 5</b>
Chromosomal Instability (CIN), Microsatellite Instability (MSI), DNA repair dysregulation and genomic instability in cancer. Epigenetics- DNA methylation, histone covalent modifications and their interplay in normal and cancer cells, An epigenetic role of RNA in cancer. Cancer susceptibility syndromes.			
<b>Module:6</b>	<b>Cancer stem cells</b>	<b>6 hours</b>	<b>CO: 5</b>
The stem cell theory of cancer, origin of cancer stem cells, markers of cancer stem cells.			
<b>Module:7</b>	<b>Cancer Diagnosis, Cancer genetics and therapeutics</b>	<b>7 hours</b>	<b>CO: 6</b>
Conventional and new diagnostic techniques, molecular screening and detection. Conventional therapy, Gene therapy, Immunotherapy, Hormone therapy, multi-targeted therapy (allele-specific, antibody-mediated inhibition of RTKs, personalized cancer therapy), patient-derived xenografts (PDXs), clonal evolution and cancer resistance.			
<b>Module:8</b>	<b>Contemporary issues</b>	<b>2 hours</b>	
Industrial Expert lecture			
	<b>Total Lecture hours:</b>	<b>45 hours</b>	
<b>Text Book(s)</b>			
1.	Robert Weinberg, The Biology of Cancer, 2013, 2 <sup>nd</sup> Edition –. Edition– 2 <sup>nd</sup> ISBN:9780815342205, Garland science publishers.		
<b>Reference Books</b>			
1.	Bunz, Fred , Principles of Cancer Genetics., 2015, 2 <sup>nd</sup> edition, Springer		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		03-08-2017	
Approved by Academic Council		No. 46	Date 24-08-2017

Course code	Course title	L	T	P	J	C
<b>BMG 5005</b>	<b>HUMAN ANATOMY AND PHYSIOLOGY</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
1. To make the students to learn the anatomical and medical terminology.						
2. To Understand the functions of different organ systems in the human body.						
3. To understand the physiological basis for the diseases and treatment.						
<b>Expected Course Outcome (CO):</b>						
1. Familiar with the medical terminology and discuss with health professionals.						
2. Describe the functions of blood.						
3. Acquire knowledge about digestive and excretory systems.						
4. Compare the functioning of endocrine and reproductive systems						
5. Relate the mechanics of respiratory and cardiovascular systems						
6. Attain a basic conceptual knowledge of brain and nervous system.						
<b>Module:1</b>	<b>Basic Anatomy &amp; Concepts of systems in human body</b>	<b>3 hours</b>				
Anatomical terminology, RBC, WBC and platelets. ABO Blood grouping.						
<b>Module:2</b>	<b>Nervous system</b>	<b>4 hours</b>				
Structure and classification of nervous. reflex action. Parts of the brain, CSF.						
<b>Module:3</b>	<b>Digestive systems</b>	<b>4 hours</b>				



Structure of alimentary canal, secretions in digestive tract, digestion and absorption of food materials, functions of liver.			
<b>Module:4</b>	<b>Excretory systems</b>	<b>4 hours</b>	
Structure of the kidney, formation of urine, functions of the kidneys.			
<b>Module:5</b>	<b>Endocrine</b>	<b>3 hours</b>	
Concepts of endocrine organs and hormones, types of hormones			
<b>Module:6</b>	<b>Reproductive system</b>	<b>5 hours</b>	
Structure of reproductive organs of male and female, Sex hormones and their functions.			
<b>Module:7</b>	<b>Circulatory systems and Respiratory system</b>	<b>5 hours</b>	
Structure of heart, circulation through arteries, capillaries and veins, factors maintaining B.P., ECG, Structure of respiratory tract, gaseous exchange in the lungs, mechanics of respiration, lung volumes.			
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>	
Industry Expert Lecture			
		<b>Total Lecture hours:</b>	<b>30 hours</b>
<b>Text Book(s)</b>			
1.	Ross and Wilson Anatomy and Physiology in Health and Illness: Janet S. Ross, Kathleen J W Wilson, Anne Waugh, Allison Grant: Books, 12th Edition, 2014, IRL press (Oxford University press, USA)		
2.	Principles of Anatomy and Physiology by Gerard J. Tortora, John Wiley & Sons; 14th Edition edition (2014)		
<b>Reference Books</b>			
1.	Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew , Fundamentals of Anatomy & Physiology, 2012, 10 Edition, Pearson Publishers.		
2.	Elaine N. Marieb , Human Anatomy & Physiology, 2014, Pearson Publishers.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		03-08-2017	
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Course code	Course title	L	T	P	J	C
<b>BMG 5006</b>	<b>Advanced Analytical Techniques</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
1. To recall methods of solution preparation and buffer concepts. 2. To explaining the principle, instrumentation and applications of different analytical instruments 3. To make use of analytical instruments for estimation of biomolecules						
<b>Expected Course Outcome (CO):</b>						
1. Define the concepts of solution formulations. 2. Explain the principle behind different instrumental methods of analyses. 3. Relate the instrumental parts with their specific roles. 4. Discuss the role of these instruments in applications related to molecular analyses. 5. Select the correct technique for specific biomolecular evaluations. 6. Experiment with different instruments for molecular separations and estimations.						
<b>Module:1</b>	<b>Electrochemical Techniques</b>	<b>6 hours</b>				
Buffers, importance of pH, Dissociation constant HH equations, Electro chemical cells; Clark oxygen electrode; biosensors- types and applications.						
<b>Module:2</b>	<b>Centrifugation</b>	<b>6 hours</b>				
Basic principle of sedimentation, centrifugation techniques, types of centrifuges and their uses.						
<b>Module:3</b>	<b>Chromatographic Techniques</b>	<b>6 hours</b>				
Adsorption and partition chromatography-column, thin layer, paper, ion-exchange, Affinity and Gas Chromatography; High performance liquid chromatography (HPLC) and HPTLC.						
<b>Module:4</b>	<b>Microscopy</b>	<b>6 hours</b>				

Basic principles of microscopy, types of microscopy, light microscope, dark field microscopy, fluorescence microscopy, concepts of electron microscopy (EM), types of EM, SEM, TEM.			
<b>Module:5</b>	<b>Immunochemical Techniques</b>	<b>6 hours</b>	
Principles and applications of immunodiffusion, immunoelectrophoresis, RIA, ELISA, avidin-biotin assays, immunofluorescence, western blotting for identifying protein and antibody.			
<b>Module:6</b>	<b>Spectroscopic techniques</b>	<b>6 hours</b>	
Theory and application of UV-VIS, IR, NMR, MS, Fluorescence, Atomic absorption spectroscopy and X-ray diffraction.			
<b>Module:7</b>	<b>Radio isotopic techniques</b>	<b>7 hours</b>	
Introduction to radioisotopes, their uses, radioactive counters, autoradiography, Positron Emission Tomography (PET). Safety aspects of radioactivity. <b>Electrophoretic techniques:</b> Isoelectric focussing, agarose gel electrophoresis, 2-dimensional gel electrophoresis, 3-dimensional gel electrophoresis, PAGE.			
<b>Module:8</b>	<b>Contemporary issues: Industrial Expert Lecture</b>	<b>2 hours</b>	
	<b>Total Lecture hours:</b>	<b>45 hours</b>	
<b>Text Book(s)</b>			
1.	1. Wilson.K and Walker 2010. Principles and Techniques of Practical Biochemistry, 7 <sup>th</sup> edition Cambridge, University Press, London.		
<b>Reference Books</b>			
1.	1. Sawhney, S.K. and Singh R.( 2010) Introductory practical biochemistry, Narosa Publisher 2. Wilson and Goulding (2010). A Biological guide to principles and techniques of practical biochemistry.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		3. 03-08-2017	
Approved by Academic Council		No. 46	Date 24-08-2017

Course code	Course title	L	T	P	J	C
<b>BMG5009</b>	<b>GENETICS OF HUMAN INFERTILITY</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
<ol style="list-style-type: none"> <li>1. To outline about human fertility, infertility, and associated genetic disorders.</li> <li>2. To relate the causes and etiology of reproductive genetic disorders</li> <li>3. To develop knowledge about the different types of assisted reproductive technologies in infertility treatment.</li> </ol>						
<b>Expected Course Outcome (CO):</b>						
<ol style="list-style-type: none"> <li>1. Infer the Embryonic development of the reproductive system.</li> <li>2. Relate that certain reproductive hormones, conditions or diseases can have genetic causes.</li> <li>3. Classify the types of male and female infertility disorders in human.</li> <li>4. Summarize the role of prenatal screening and testing in pregnancy management and care and the options available when a fetal abnormality is detected.</li> <li>5. Utilize the applications of assisted reproductive technologies in infertility treatment.</li> <li>6. Explain how reproductive genetic diseases influence both individual and family as a society.</li> </ol>						
<b>Module:1</b>	<b>Human Reproductive System</b>	<b>5 hours</b>				
Embryonic development of the female and male reproductive system, Reproductive system of women and men, Oogenesis, Spermatogenesis.						
<b>Module:2</b>	<b>Reproductive Hormones</b>	<b>4 hours</b>				
Reproductive hormones- Estrogen, Follicle Stimulating Hormone, Gonadotropin-Releasing Hormone, Human Chorionic Gonadotropin Hormone, Luteinizing Hormone, Oxytocin, Progesterone, Prolactin, Testosterone.						

<b>Module:3</b>	<b>Female infertility</b>	<b>5 hours</b>	
The Genetics and types of female Infertility, amenorrhea, abnormal uterine bleeding, reproductive tract abnormalities (acquired and developmental), androgen disorders, recurrent abortion, fertility after cancer treatment.			
<b>Module:4</b>	<b>Male infertility</b>	<b>4 hours</b>	
The Genetics and types of male Infertility, meiotic errors, and male infertility, environmental influences on male infertility, cryptorchidism. Clinical evaluation of male infertility, Y-Chromosome microdeletions.			
<b>Module:5</b>	<b>Application of Assisted Reproductive Technologies in Infertility</b>	<b>4 hours</b>	
Diagnosis- Prenatal diagnosis- amniocentesis, chorionic villus sampling, Preimplantation Genetic Diagnosis (PGD). Treatment – Assisted Reproductive Technologies (ART) –IVF, ICSI, GIFT and ZIFT, Recent advances in Artificial Reproductive Techniques.			
<b>Module:6</b>	<b>Reproductive Genetic counseling</b>	<b>4 hours</b>	
When and who can utilize Prenatal diagnosis, Sperm count management, Prenatal Testing & Eugenics. Ethical dilemmas in PGD and ART. Preconception and prenatal assessment of genetic risk and counseling.			
<b>Module:7</b>	<b>Socioeconomic problems</b>	<b>2 hours</b>	
Usefulness of genetic tests and their risks, benefits, and impact on society. Socioeconomic problems, the status of infertility in developed and developing countries.			
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>	
Industry expert lecture			
		<b>Total Lecture hours:</b>	<b>30 hours</b>
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
<b>Project:</b>			
<b>Text Book(s)</b>			
1.	Björn Glantz and Klas Edquist, Hauppauge, N.Y., Male and Female Infertility: Genetic Causes, Hormonal Treatments and Health Effects (Human Reproductive System-- Anatomy, Roles, and Disorders), 2011. Nova Science Publishers.		
<b>Reference Books</b>			
1	Lipshultz, Larry I., Stuart S. Howards, and Craig S. Niederberger, eds. Infertility in the Male. , 2012, 4th ed. Cambridge: Cambridge University Press.		
2	Rizk, Botros R. M. B., et al., eds. Infertility and Assisted Reproduction. 2010, 2 <sup>nd</sup> ed. Cambridge: Cambridge University Press,		
<b>Mode of Evaluation:</b> CAT / FAT / Assignment			
Recommended by Board of Studies		<b>03-08-2017</b>	
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<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
<b>BMG5010</b>	<b>Radiation Genetics</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
		v. XX.XX				
<b>Course Objectives (CoB):</b>						
<ol style="list-style-type: none"> <li>1. To interpret the effects of radiation exposure on biological systems and medical exposure levels</li> <li>2. To apply the methods for measuring, monitoring radiation and radio-protection</li> <li>3. To assess radiation carcinogenesis and appraise about clinical radiobiology</li> </ol>						
<b>Expected Course Outcome (CO):</b>						
<ol style="list-style-type: none"> <li>1. Outline the basic concepts in radiation physics, chemistry and biological aspects of radiation</li> <li>2. Elaborate the mechanisms and consequences of radiation-induced injury and radiation pathogenesis</li> <li>3. Interpret the effects of radiation in cancer</li> <li>4. Explain DNA damage, repair and application of biodosimetry techniques</li> <li>5. Discuss the recent advances in radiation biology and application of diagnostic techniques in radiobiology/cancer therapy</li> <li>6. Identify the biomarkers for monitoring radiation exposed population or in carcinogenesis</li> </ol>						
<b>Module:1</b>	<b>Radiation Physics and Radiation Chemistry</b>	<b>5 hours</b>			<b>CO: 1</b>	
Internal and external sources of radiation, types of radiation and their properties. Ionization and excitation, Interaction of radiation with matter. Direct and indirect effects of radiation. Units of radiation						

measurement.			
<b>Module:2</b>	<b>Cellular responses to radiation</b>	<b>5 hours</b>	<b>CO: 1</b>
Radiolysis of water and radical formation. Cell survival curve (concepts of D0, D37, shoulder, extrapolation number). Factors affecting survival- RBE, oxygen effect, sensitizers and protectors. Cell cycle stage and radiation sensitivity			
<b>Module:3</b>	<b>Radiation Induced Injury</b>	<b>4 hours</b>	<b>CO: 2</b>
Law of Bergonie and Tribondeau. Stochastic Effect, Deterministic effect, Bystander effects. Dose fractionation, Radiotherapy. Radiation cataractogenesis			
<b>Module:4</b>	<b>Radiation pathology</b>	<b>4 hours</b>	<b>CO: 2</b>
Somatic effects of whole body radiation exposure. Effect on the immune response. Radiation syndromes: Bone marrow, Gastrointestinal and Cerebrovascular (central nervous system) syndromes.			
<b>Module:5</b>	<b>Radiation carcinogenesis</b>	<b>4 hours</b>	<b>CO: 3</b>
Long term effects of radiation. Radiation carcinogenesis. Risk estimates for radiation induced cancer. Genetic effects of radiation.			
<b>Module:6</b>	<b>Radiation dosimetry</b>	<b>3 hours</b>	<b>CO: 4</b>
Radiation protection, ICRP, Radon, DNA damage and chromosome aberration. Molecular techniques in radiation biology.			
<b>Module:7</b>	<b>Diagnostic Radiobiology</b>	<b>3 hours</b>	<b>CO: 5</b>
Clinical applications of radiation biology. The radiation sensitive syndromes (XP, FA).Treatment of radiation accident victims. Recent advances in radiation Genetics			
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>	<b>CO: 6</b>
Industry Expert lecture			
	<b>Total Lecture hours:</b>	<b>30 hours</b>	
<b>Text Book(s)</b>			
1	Lippincott, Williams and Wilkins Hall, E.J. and Giaccia, A.J. Radiobiology for the Radiologist, 2012, (7th edition). Philadelphia, Publishers		

2	Friedberg, E.C., Walker, G.C., and Siede, W, DNA Repair and Mutagenesis,2011, ASM Press		
<b>Reference Books</b>			
1.	Umadevi. P, Nagarathnam. A and Satish Rao. B.S., Introduction to radiation biology.2011, B.I. Churchill Livingstone, Pvt. Ltd., New Delhi.		
2.	Shirley Lehnert Biomolecular Action of Ionizing Radiation,2011, Taylor and Francis.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
<b>Mode of Evaluation:</b> CAT / FAT / Assignment			
Recommended by Board of Studies		03-08-2017	
Approved by Academic Council		No. 46	Date 24-08-2017

Course code	Course title	L	T	P	J	C
<b>BMG5011</b>	<b>COGNITIVE AND BEHAVIOURAL GENETICS</b>	2	0	0	4	3
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
<b>Course Objectives (CoB):</b>						
1. To understand the aspects of cognition, language, emotion, personality, and behaviour in genetic disorders 2. To estimate the risk factors for psychological disorders and variation in behavioural and personality traits. 3. To analyse neurogenetic disorder using molecular genetics						
<b>Expected Course Outcome (CO):</b>						
1. Outline the basics of neurobiology and neurogenetics 2. Identify appropriate techniques to analyse the neurogenetic disorder 3. Determine the gene-environment interaction in humans 4. Illustrate the importance of genetic factors in the etiology (causes) of mental disorders 5. Analyze the clinical condition and recommend for clinical management 6. Apply the knowledge from recent advances in neurosciences						
<b>Module:1</b>	<b>Organ and Hormone function</b>	<b>4 hours</b>		<b>CO: 1</b>		
Over view of human brain, neurons, mind - structure and function, Hormone and behavior						



<b>Module:2</b>	<b>Neurogenetics</b>	<b>4 hours</b>	<b>CO: 1</b>
Cognitive and behavioral phenotypes, Neural basis of behavior, Nature and nurture forms of behavior. Genes, environment and genesis of psychopathology			
<b>Module:3</b>	<b>Major techniques in behavioral genetics</b>	<b>4 hours</b>	<b>CO: 2</b>
Discoveries of behavioral genetics Quantitative genetics – Family, twin and adoption studies. Gene mutations, Huntington’s Disease, a single gene autosomal dominant mutation.			
<b>Module:4</b>	<b>Environmental and Genetic Context</b>	<b>4 hours</b>	<b>CO: 3</b>
Genomic, cellular and local environment, Impulsive behavior – positive and negative impulsive traits, Intelligence.			
<b>Module:5</b>	<b>Genetics of mental disorders</b>	<b>3 hours</b>	<b>CO: 4</b>
Genetics of Language- Heritability of normal variation and pathologies of language. Specific Language Impairment. Dyslexia, Developmental language delay, Stuttering.			
<b>Module:6</b>	<b>Neuro Disorders</b>	<b>4 hours</b>	<b>CO: 4</b>
Mood disorders – Bipolar disorders, manic depressive illness and alcoholism.			
<b>Module:7</b>	<b>Genetics of childhood disorders</b>	<b>5 hours</b>	<b>CO: 4,5</b>
Autistic spectral disorders, psychotic disorders – schizophrenia. Clinical applications- Implications for diagnosis and treatment, Genetic counseling and testing. Social and ethical concomitants of cognitive and behavioral genetics: eugenics, social Darwinism, race.			
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>	<b>CO: 6</b>
Industry expert lecture			
	<b>Total Lecture hours:</b>	<b>30 hours</b>	
<b>Text Book(s)</b>			
1.	Plomin, R., DeFries, J.C., McClearn, G.E., & McGuffin, P 2010. Behavioral Genetics. 5th ed. New York: Worth Publishers		
2.	Bryan Kolb; Ian Q Wishaw; G Campbell Teskey 2016. An Introduction to Brain and Behavior. 5 <sup>th</sup> edition Worth Publishers, New York		
<b>Reference Books</b>			

1.	Nuffield Council on Bioethics, Genetics of Human Behavior, 2010, ISBN- 190438403X		
2.	Peter Mc Guffin, M.J.Owen, I.Gottesman Psychiatric genetics and genomics,2011. Oxford University Press		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	03-08-2017		
Approved by Academic Council	No. 46	Date	24-08-2017

Course code	Course title	L	T	P	J	C
BMG5012	FORENSIC SCIENCE	2	0	0	4	3
Pre-requisite	NIL	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
<ol style="list-style-type: none"> <li>To emphasize the importance of scientific methods in crime detection.</li> <li>To disseminate information on the advancements in the field of forensic science.</li> <li>To highlight the importance of forensic science for perseverance of the society.</li> </ol>						
<b>Expected Course Outcome (CO):</b>						
<ol style="list-style-type: none"> <li>Helping students discover the field of forensics and its related departments</li> <li>Demonstrate competency in the collection, processing, analyses, and evaluation of evidence.</li> <li>Discuss the principle of crime scene investigation, including the recognition, collection, identification, preservation, and documentation of physical evidence.</li> <li>Demonstrate an understanding of the scientific method and the use of problem-solving within the field of forensic science.</li> <li>Identify the role of the forensic scientist and physical evidence within the criminal justice system.</li> <li>Able to document and orally describe crime scenes, physical evidence, and scientific processes.</li> <li>Identify and examine current and emerging concepts and practices within the forensic science field.</li> </ol>						

<b>Module:1</b>	<b>Forensic Science, Development and Significance</b>	<b>3 hours</b>	<b>CO: 1</b>
History and Significance, Experts involved and procedures in crime scene investigative, Forensic laboratories: National and Global laboratories, Body farms, Recent advances in Forensic Science.			
<b>Module:2</b>	<b>Crime Investigation Protocol and Instrumentation</b>	<b>3 hours</b>	<b>CO: 2</b>
Evidences: Physical Evidence, procedures in collection, documentation, and Chain of Custody, Instrumentation in Forensic Analysis.			
<b>Module:3</b>	<b>Fingerprinting in Forensic Science</b>	<b>3 hours</b>	<b>CO: 3</b>
Principle, Types, Fingerprint lifting techniques and Documentation, Fingerprint Recorders: Biometric system in detecting individual variation, Optical, Capacitance-based and other types of fingerprint recorders.			
<b>Module:4</b>	<b>Document Analysis, Impression Based Evidences</b>	<b>4 hours</b>	<b>CO: 4</b>
Impression based evidence: Principle, Tool markings, Tire, Footwear markings and associated databases, Hand writing analysis, Question documents, Polymers and fibers.			
<b>Module:5</b>	<b>Ballistics Principles and Study in Crime Analysis</b>	<b>4 hours</b>	<b>CO: 5</b>
Types, application, procedures: internal, external and terminal ballistics, and identification of firearms, databases in ballistic analysis.			
<b>Module:6</b>	<b>Pathology, Toxicology and DNA fingerprinting in Forensics</b>	<b>6 hours</b>	<b>CO: 6</b>
Analysis of blood, saliva, semen at crime scene, Blood Spatter- Origin of impact studies, Abusive Drug types, CSA- schedules, Poisons and analysis. Time of death analysis; Entomology and pathology in death analysis, Bite-mark analysis, Forensic Medicine. DNA fingerprinting: RFLP and PCR (VNTR, STR-CODIS) based profiling.			
<b>Module:7</b>	<b>Digital media and Information Science in Forensic Sciences</b>	<b>5 hours</b>	<b>CO: 7</b>
Photographic Applications: SLR-camera, Digital camera, CCTV in forensic analysis, Camera techniques for evidence visualization, Forensic Facial Reconstruction. Cyber Forensics: Computer, Mobile phone data analysis, Ethical hacking, drones, remote surveillance in forensic investigations, and Corporate crimes. Deception detection tests (DDT): polygraph, narco-analysis and brain-mapping. Forensic and Legal proceedings in India: Legal proceedings in forensics, CSI in India, and Case study			
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>	<b>CO: 7</b>
Industry Expert lecture			
		<b>Total Lecture hours:</b>	<b>30 hours</b>
<b>Text Book(s)</b>			
1.	Criminalistics: An Introduction to Forensic Science, 11/E, Richard Saferstein, 2015, ISBN-10:0133458822 ISBN-13: 9780133458824, • Prentice Hall		
<b>Reference Books</b>			

1.	Forensic DNA Typing, , Biology, Technology, and Genetics of STR Markers, J Butler, 2010, 3 <sup>rd</sup> Edition , Imprint: Academic Press, eBook ISBN : 9780080470610, Print Book ISBN : 9780121479527, Pages: 688		
2.	Introduction to Criminalistics: The Foundation of Forensic Science, 2010, by Barry A.J. Fisher, William J. Tilstone, Catherine Woytowicz, Elsevier Academic Press USA,.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		03-08-2017	
Approved by Academic Council		No. 49	Date 24-08-2017

Course code	Course title	L	T	PJ	C
<b>BMG5013</b>	<b>STEM CELL BIOLOGY</b>	<b>3</b>	<b>0</b>	<b>00</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>			
		<b>1.1</b>			
<b>Course Objectives (CoB):</b>					
1.	To elaborate upon the fundamental and conceptual aspects of stem cell biology				
2.	To dissect the mechanistic aspects				
3.	To interpret technical information in peer-reviewed papers				
<b>Expected Course Outcome (CO):</b>					
1.	Able to recall and demonstrate proficiency in the theoretical aspects of the subject (mechanistic/basic and applied aspects)				
2.	Discuss latest techniques in stem cell culture				
3.	Compare and distinguish the principle and the latest methodologies used in stem cell research (identification, localization, lineage tracing and differentiation potential)				
4.	Improve their technical writing skills; make presentations and design experiments				
<b>Module:1</b>	<b>Introduction to cell &amp; Stem cell Biology</b>	<b>6 hours</b>	<b>CO: 1</b>		
General definitions. Overview of stem cell isolation methods, overview of cell cycle, proliferation, differentiation and transdifferentiation (cell Vs stem cell). Overview of Quiescence, Self-renewal and Pluripotency; types of stem cell (primate Vs mouse Vs human); politics and ethics.					
<b>Module:2</b>	<b>Stem cell niche, epigenetics &amp; Signal Transduction pathways</b>	<b>6 hours</b>	<b>CO:2</b>		
Niche – localization, molecular aspects. Epigenetics – classification and analysis of factors regulating stem cell fate, latest methods for dissecting the mechanisms. Integration of signal transduction pathways.					

<b>Module:3</b>	<b>Stem cell Invertebrate Model Systems</b>	<b>6 hours</b>	<b>CO: 3</b>
Stem cell systems in sponge, immortal hydra, basal flatworm, ascidians – latest methods and techniques.			
<b>Module:4</b>	<b>Stem cell in Vertebrate Systems</b>	<b>5 hours</b>	<b>CO: 3</b>
Stem cell in amphibian and mouse. Similarities and differences between mouse and human embryonic stem cell/epiblast stem cell –latest methods and techniques.			
<b>Module:5</b>	<b>Keratinocyte and hair follicle stem cells</b>	<b>6 hours</b>	<b>CO: 3</b>
Identification, localization and tracing; regenerative potential-latest methods and techniques.			
<b>Module:6</b>	<b>Mesenchymal Stem cell</b>	<b>7 hours</b>	<b>CO: 3</b>
Immunomodulatory role/ therapeutic/ engraftment potential, proliferation and differentiation protocols- latest methods and techniques.			
<b>Module:7</b>	<b>Hematopoietic Stem cells</b>	<b>7 hours</b>	<b>CO:3</b>
HSCs –subpopulations and the niche. Reconstitution experiments, HSCs in therapy –success stories. Induced Pluripotent Stem cells (iPSCs) - Production methods Disease Modeling; iPSC in therapy. Overview of regenerative science.			
<b>Module:8</b>	<b>Contemporary issues</b>	<b>2 hours</b>	<b>CO: 4</b>
Industry Expert Lecture			
	<b>Total Lecture hours:</b>	<b>45 hours</b>	
<b>Text Book(s)</b>			
1.	Essentials of Stem Cell Biology. 3 <sup>rd</sup> edition. (2014). Elsevier Inc. Academic Press USA.		
2.	Stem Cell Biology & Regenerative Medicine. From Molecular Embryology to Tissue Engineering (2011). Appasani K. & Appasani R.K. Humana Press.		
<b>Reference Books</b>			
1.	Stem Book. <a href="http://www.stembook.org/">http://www.stembook.org/</a> . (2013) Massachusetts General Hospital. Boston, USA.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
<b>Recommended by Board of Studies</b>		03-08-2017	
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<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
<b>BMG5014</b>	<b>ENVIRONMENTAL GENETICS</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>4</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
<ol style="list-style-type: none"> <li>The objective of this course is to introduce the graduate about the chemical basis of heredity.</li> <li>To acquire knowledge about mutagenesis, mutagens, carcinogenesis and teratogens.</li> <li>To develop, implement, monitor and maintain environmental strategies that will promote sustainable development.</li> </ol>						
<b>Expected Course Outcome (CO):</b>						
<ol style="list-style-type: none"> <li>Describe the roles of genes and the environment in the determination of phenotype.</li> <li>Analyse the sources of mutagenic, carcinogenic, and teratogenic chemicals in the environment and identify their known effects.</li> <li>Plan and carry out experiments in animal models to evaluate the risk of mutagens and teratogens which can be responsible for inherited and acquired ailment or conditions, such as cancer</li> <li>Recognize and evaluate the different types of toxicity in the environment that causes health and environmental hazards.</li> <li>Understand and explain the importance of molecular approaches in Environmental Genetics.</li> <li>Utilize quantitative knowledge and skills and modern tools and technologies to assess, analyse, plan, and implement environmental management systems</li> </ol>						
<b>Module:1</b>	<b>Environment and mutations</b>	<b>6 hours</b>				
Emerging global environmental health problems. Modification of mutagenic damage, antimutagenesis and desmutagenesis.						
<b>Module:2</b>	<b>Risk analysis of Biomarkers</b>	<b>6 hours</b>				
Biomarkers and risk analysis, mutagenesis and carcinogenesis, Procedures for assessment of genotoxicity.						

<b>Module:3</b>	<b>Mammalian systems for mutagenicity assessment</b>	<b>7 hours</b>
<p>Mouse- cytogenetic procedures and techniques to assess gene mutations. Fibroblasts and chinese hamster cells in culture- Unscheduled DNA synthesis, Chromosomal aberrations, Sister chromatid exchanges, gene mutation- HGPRT and TK</p>		
<b>Module:4</b>	<b>Evaluation of mutagens</b>	<b>6 hours</b>
<p>Interrelationship between mutagenesis and Carcinogenesis- Tests for evaluation. Xenobiotics metabolism.</p>		
<b>Module:5</b>	<b>Teratogens</b>	<b>6 hours</b>
<p>Mouse as a test system – congenital anomalies- teratogens in comparison with mutagens and carcinogens- birth defects in humans.</p>		
<b>Module:6</b>	<b>Structural defects of DNA</b>	<b>6 hours</b>
<p>DNA mutagen adducts and altered DNA conformation- DNA repair defects in humans.</p>		
<b>Module:7</b>	<b>Biomonitoring of human population</b>	<b>6 hours</b>
<p>Chromosomal analysis, Sperm morphology analysis. Nutritional Toxicants - Toxicology and Epidemiology of human exposure to pesticides and food toxicants.</p>		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
<p>Expert Lecture from Industry or Hospital</p>		
<b>Total Lecture hours:</b>		<b>45 hours</b>
<b>Text Book(s)</b>		
1.	Chemical Mutagens- Principles and methods for their detection, Plenum Press, 2011. New York,	
2.	Hand Book of Epigenetics: The New Molecular and Medical Genetics. 2011, Academic Press UK	
<b>Reference Books</b>		
1.	Handbook of Mutagenicity test procedures, Kilbey <i>et al.</i> , 2011 (ed.) Elsevier, Amsterdam,	
2.	Venite, S and Parry, J.M , Mutagenicity testing- A practical approach,. 2011. IRL Press,	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
<b>List of Challenging Experiments (Indicative)</b>		
1.	Analysis of induced chromosome aberration in Leukocyte Culture by Chemical mutagens.	2 hours
2.	Analysis of induced chromosome aberration in Leukocyte Culture by radiation	2 hours
3.	Sister chromatid exchange analysis.	2 hours
4.	Micronucleus test.	2 hours
5.	Sperm abnormality Analysis	3 hours
6.	Chromosome Preparation from Mouse bone marrow.	3 hours
7.	DNA damage analysis.	3 hours
8.	DNA fragmentation	3 hours
<b>Total Laboratory Hours</b>		<b>30 hours</b>
<b>Mode of Evaluation:</b> Continuous assessment Test/ Assignment/ Quiz/ Final Assessment test.		

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Course code	Course title	L	T	P	J	C
<b>BMG5015</b>	<b>INTRODUCTION TO HUMAN PSYCHOLOGY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>Nil</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
<ol style="list-style-type: none"> <li>To introduce the students to the subject of psychology, nature, scope and schools of psychology.</li> <li>To familiarize the methods used in psychology and to facilitate their knowledge about causes of behavior.</li> <li>To provide the knowledge of basic concepts in psychology</li> </ol>						
<b>Expected Course Outcome (CO):</b>						
<ol style="list-style-type: none"> <li>Use scientific reasoning to interpret psychological phenomena</li> <li>Engage in innovative and integrative thinking and problem solving</li> <li>Interpret, design, and conduct basic psychological research</li> <li>Student will be able to work effectively in teams</li> <li>Communicate better and understand the diversity of human behaviour.</li> <li>To have a more open sense of mind towards the people suffering from various psychological issues and disorder in the society and be a good citizen</li> </ol>						
<b>Module:1</b>	<b>Introduction and Methods</b>	<b>6 hours</b>				
Science of Psychology, Behaviorism, Humanism, Sensation and perception, Emotion, Cognitive abilities and Intelligence.						
<b>Module:2</b>	<b>Physiological Psychology</b>	<b>6 hours</b>				
Relationship between behavior and physiological processes, Neurophysiological processes, Study of human behavior.						



<b>Module:3</b>	<b>Therapeutic Approaches</b>	<b>6 hours</b>
Psychodynamic therapies, Indigenous therapies, Bio-feedback therapy, Fostering mental health.		
<b>Module:4</b>	<b>Counselling Psychology</b>	<b>6 hours</b>
Basic Counseling skills, Counselor self-care, Integrative therapies Common Factors, Positive Psychology, Family Systems therapy, Behavior therapies, Client centered therapy, Cognitive therapies.		
<b>Module:5</b>	<b>Rehabilitation Psychology</b>	<b>7 hours</b>
Primary, secondary and tertiary prevention programmes - role of psychologists, Organizing of services for rehabilitation of physically, mentally and socially challenged persons including old persons, Rehabilitation of persons suffering from substance abuse, juvenile delinquency, criminal behavior, Rehabilitation of victims of violence, Rehabilitation of HIV/AIDS victims.		
<b>Module:6</b>	<b>Social Psychology</b>	<b>6 hours</b>
Issues of discrimination, Management of diversity, Glass ceiling effect, Self-fulfilling prophesy, Arousing community consciousness and action for handling social problems, Group decision making and leadership for social change, Effective strategies for social change, Women and Indian society.		
<b>Module:7</b>	<b>Applications-I</b>	<b>6 hours</b>
Distance learning through IT and mass media, Entrepreneurship through e-commerce; Psychological consequences of recent developments in Information Technology, Achievement motivation and economic development. Applications- II: Motivating and training people for entrepreneurship and economic development, Consumer rights and consumer awareness, Population psychology.		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
Industry Expert Lecture		
<b>Total Lecture hours:</b>		<b>45 hours</b>
<b>Text Book(s)</b>		
1.	Clifford T. Morgan, Richard A. King, John R. Weisz, John Schopler- Introduction to Psychology, 7th Edition, 2010 ,Tata Mcgraw Hill Edition-.	
<b>Reference Books</b>		
1.	Edward E. Smith, Susan Nolen, Hoeksema, Barba Fredickson, Geoffer R Lottus Introduction to Psychology, 14th Edition , 2011, Atkinson and Hilgar's-	
2.	Shelley E. Taylor, Letitia Anne Peplan, David O. Sears, Social Psychology-12th Edition 2011, Pearsons Education,.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
Recommended by Board of Studies		03-08-2017
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<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
<b>BMG5016</b>	<b>Bioinformatics</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>4</b>
<b>Pre-requisite</b>	Nil	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives:</b>						
<ol style="list-style-type: none"> <li>1. To introduce the basic concepts, methods and tools employed in Bioinformatics.</li> <li>2. To solve biological problems using bioinformatics tools</li> <li>3. To utilize the wide variety of tools, servers, biological databases.</li> </ol>						
<b>Expected Course Outcome</b>						
<ol style="list-style-type: none"> <li>1. Apply knowledge of the basic concepts of biology, computer science and mathematics</li> <li>2. Use the information in computer modelling</li> <li>3. Appraise structure-function relationships, database queries</li> <li>4. Reach rapidly the frontier of bioinformatics.</li> <li>5. Formulate biological big data to unlock the next big biotech discovery.</li> </ol>						
<b>Module:1</b>	<b>Biological Database</b>	<b>4 hours</b>				
NCBI, EMBL, Uniprot, PDB and other biological databases, File Formats - sequence formats, Scope and application of Bioinformatics						

<b>Module:2</b>	<b>Sequence Alignment techniques</b>	<b>4 hours</b>
Introduction to Sequences alignments - Dot plot and Dynamic Programming – Local alignment smith waterman algorithm – Global alignment - Needleman-wunsch - (algorithm and example)		
<b>Module:3</b>	<b>Scoring Matrices and Multiple sequence alignment</b>	<b>4 hours</b>
Gap penalty, types, substitution scoring matrices, multiple sequence alignment – Clustal W algorithm - Feng Doolittle algorithm, star method, applications		
<b>Module:4</b>	<b>Heuristic methods</b>	<b>4 hours</b>
Similarity Searches on Sequence Databases - Heuristic Sequence Alignment -BLAST and its types, FASTA – Algorithms -Sensitivity, specificity, applications		
<b>Module:5</b>	<b>Genome annotation</b>	<b>4 hours</b>
Principles of Genome annotations, Annotation tools and resources, Comparative Genomics- Patterns and mechanisms in genome evolution Next Generation Sequencing (NGS).		
<b>Module:6</b>	<b>Molecular Phylogenetics</b>	<b>3 hours</b>
Tree construction– Distance based method, Character-Based Methods- Maximum parsimony method, Maximum likelihood- Phylogenetic Tree Evaluation – Jack-knifing and Bootstrapping - applications		
<b>Module:7</b>	<b>Molecular modelling and In silico Drug design</b>	<b>5 hours</b>
Protein secondary structure prediction – 3D structure Prediction – Homology Modelling, Threading, tools for structure prediction Ligand based Drug design, Target based drug design, Virtual screening, SBDD, docking, QSAR, ADME prediction.		
<b>Module:8</b>	<b>Contemporary issues</b>	<b>2 hours</b>
Industrial Expert lecture		
	<b>Total Lecture hours:</b>	<b>30 hours</b>
<b>Practical</b>		
1	Retrieval and analysis of Nucleotide sequence from primary nucleotide database	

		2 Hrs
2	Exploring Protein sequence from protein database	2 Hrs
3	Annotation of Protein structure from structure database	2 Hrs
4	Access of secondary biological data from various Biological database	2 Hrs
5	Pairwise alignment using dot plot (Virtual mode)	2 Hrs
6	Pairwise alignment using dynamic programming	2 Hrs
7	Heuristic Sequence Alignment using BLAST/ FASTA	4 Hrs
8	Multiple sequence alignment (Virtual mode)	2 Hrs
9	Construction of Phylogenetic tree	2 Hrs
10	Gene prediction analysis	2 Hrs
11	Prediction of secondary structure of protein.	4 Hrs
12	Visualization of protein Structure	4 Hrs
	<b>Total hours</b>	30 Hrs
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
	<b>Project: "J Component"</b>	
<b>Text Books:</b>		
	1. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellette, B.F., Wiley India Pvt Ltd. 2009 2. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004.	
<b>Reference Books:</b>		
	1. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith, Pearson Education. 1999. 2. Bios Instant Notes in Bioinformatics by Hodgman, Andrew and David R. Westhead, Taylor and Francis, 2007.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
Recommended by Board of Studies	03-08-2017	
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Course code	Course title	L	T	P	J	C
<b>BMG5017</b>	<b>ENZYMOLGY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
		1.1				
<b>Course objectives (CoB):</b>						
<ol style="list-style-type: none"> <li>1. To introduce students to various theoretical and practical aspects of enzymology</li> <li>2. To stimulate their interest in learning the structure, function and kinetics of enzyme and their role as catalyst and regulator of cell metabolism.</li> <li>3. To serve as foundation for more advanced enzymology courses.</li> </ol>						
<b>Expected Course Outcome (CO):</b>						
<ol style="list-style-type: none"> <li>1. Compare various classes of enzyme and their functions in the cell;</li> <li>2. Importance of co-enzyme or cofactor in enzyme catalyzed reaction</li> <li>3. Distinguish between equilibrium and steady state kinetics</li> <li>4. Extend role of enzymes as clinical markers</li> <li>5. Demonstrate isolation and purification of enzymes</li> <li>6. Elaborate various applications of enzymes in industry</li> </ol>						
<b>Module:1</b>	<b>Introduction to enzymes</b>	<b>6 hours</b>				
Biochemical importance, properties, structure, active site features, organisation- multienzyme complex, isoenzymes, classification and nomenclature.						
<b>Module 2</b>	<b>Fundamentals of Enzyme Kinetics</b>	<b>6 hours</b>				
Activation energy, Reaction co-ordinate diagram, MM kinetics-kinetic constants - $K_m$ , $K_{cat}$ , Line weaver Burk plot, Factors influencing enzyme activity.						

<b>Module:3</b>	<b>Enzyme inhibitors as drugs</b>	<b>6 hours</b>
Enzyme inhibition, types-reversible & irreversible, enzyme inhibitors as drugs for various diseases.		
<b>Module:4</b>	<b>Enzyme catalysis and regulation</b>	<b>6 hours</b>
Acid base catalysis, covalent catalysis, metal ion catalysis, proximity effect RNase, chymotrypsin, carbonic anhydrase. Enzyme regulation – covalent modification, allosteric regulation with examples		
<b>Module:5</b>	<b>Enzyme extraction &amp; purification</b>	<b>6 hours</b>
Enzyme sources, intracellular & extracellular enzymes- isolation methods, purification & characterization of industrial enzymes		
<b>Module:6</b>	<b>Clinical enzymology</b>	<b>6 hours</b>
Importance of enzymes in various disorders: LDH and isoenzymes, CPK, AST, ALT, ALP, ACP, GPD, Amylase, Lipase, GGT, enzyme based biosensors. Enzymes in therapy-asparaginase, urokinase, lactamase, uricase.		
<b>Module:7</b>	<b>Enzymes assays &amp; Industrial applications</b>	<b>7 hours</b>
Measurement of enzyme activity, units, types – direct, indirect, role of enzymes as analytical agents in coupled assays. Immobilized enzymes & its applications. Applications of enzyme technology: Recent developments in enzymatic assays. Industrial production & applications of enzymes. Enzyme engineering, synzymes and applications.		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
	Industry Expert Lecture	
<b>Total Lecture hours:</b>		<b>45 hours</b>
<b>Text Book(s)</b>		
1.	Trevor palmer and Philip Boner, Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, 2011	
<b>Reference Books</b>		

1.	Martin F. Chaplin, Christopher Bucke, Enzyme Technology , 2010. ISBN/ASIN: 0521348846. ISBN-13: 9780521348843 Cambridge University Press		
2.	Nicholas Price and Lewis Stevens , Fundamentals of Enzymology, Cell and Molecular Biology of Catalytic Proteins. 2012, 3rd Edition, Oxford University Press.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	03-08-2017		
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Course code	Course title	L	T	P	J	C
<b>BMG6001</b>	<b>HUMAN BIOCHEMICAL GENETICS</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
1. To gain knowledge on the basic principles of metabolic pathways 2. To identify the changes in metabolic pathways in various biochemical disorders 3. To introduce them the genetics of metabolic pathways and associated abnormalities						
<b>Expected Course Outcome (CO):</b>						
1. Acquire knowledge on molecular basis of human genetic diseases 2. Identify the inborn errors of amino acid metabolism and interpret the genetics of metabolic syndrome 3. Categorise hemoglobinopathies and its prevalence in India storage disorders 4. Develop knowledge on the genetics of storage disorders such as lysosomal, mucopolysaccharides and lipids 5. Relate the types of muscular dystrophies and associated biochemical abnormalities 6. Compare the genetic defect with the metabolic diseases.						
<b>Module:1</b>	<b>Introduction to Biochemical disorders</b>	<b>2 hours</b>				
Biochemical and molecular basis of human genetic diseases.						
<b>Module:2</b>	<b>Disorders of Amino Acid Metabolism</b>	<b>4 hours</b>				
PKU, Alkaptonuria, Homocystinuria, Albinism.						

<b>Module:3</b>	<b>Genetics of Metabolic Syndromes</b>	<b>5 hours</b>
Galactosemia, Diabetes, Lactic acidosis, G-6 PD deficiency and glycogen storage disorders. Lesch Nyhan syndrome, Gout and pseudogout.		
<b>Module:4</b>	<b>Haemoglobinopathies</b>	<b>4 hours</b>
Classification, globin gene structure and mutation, biochemistry of Thalassaemia, Sickle cell anemia and other haemoglobin variants. Haemoglobinopathies in India.		
<b>Module:5</b>	<b>Storage Disorders</b>	<b>4 hours</b>
Classification of lysosomal storage disorders. Molecular Genetics of Mucopolysaccharidoses and Lipidosis		
<b>Module:6</b>	<b>Muscular Dystrophies</b>	<b>4 hours</b>
Muscular dystrophies - Duchenne muscular dystrophy, Becker muscular dystrophy, Distal muscular dystrophy, Emery– Dreifuss muscular dystrophy, Myotonic muscular dystrophy, Limb-girdle muscular dystrophy, Cystic fibrosis.		
<b>Module:7</b>	<b>Biochemical diagnosis</b>	<b>5 hours</b>
New born screening and population screening for biochemical disorders. Genetic registries and prevention of inherited metabolic disorders. Metabolism and Metabolic Disease Resources on the Web. Biochemical disease management: Clinical Management of Inborn Errors of Metabolism, Metabolic Disorders and Counseling Issues.		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2hours</b>
Industry Expert Lecture		
<b>Total Lecture hours:</b>		<b>30 hours</b>
<b>Text Book(s)</b>		
1.	Lee B and Scalia F Inborn Errors of Metabolism From Neonatal Screening to Metabolic Pathways, 2014, Oxford Monographs on Medical Genetics.	
<b>Reference Books</b>		
1.	T.M. Devlin, 2010. Textbook of Biochemistry with clinical correlations (7th edn.). D.J.	
2.	A.E.H. Emery and D.L. Rimoin 2013. Principles and Practice of Medical Genetics, Vol. II, Churchill, Livingston, Chap.99	
3.	Alan E. H. Emery, Francesco Muntoni, and Rosaline C. M. Quinlivan 2015 Duchenne Muscular Dystrophy Fourth Edition, Oxford	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
Recommended by Board of Studies		03-08-2017
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Course code	Course title	L	T	P	J	C
BMG6003	MEDICAL BIOCHEMISTRY	3	0	0	0	3
Pre-requisite	Nil	Syllabus version				
		1.1				
<b>Course Objectives (CoB):</b>						
<p>1. To provide a breadth of knowledge, from basic principles to the latest cutting-edge developments in biochemistry, and develop analysis skills to understand biochemical data.</p> <p>2. To demonstrate clinical disorders, the biochemical consequences of particular disease process and the response to therapy.</p> <p>3. To develop skills for understanding the clinical case studies with the help of interpretation of laboratory results.</p>						
<b>Expected Course Outcome (CO):</b>						
<p>1. Interpret the metabolic effects following influence on individual reaction steps by clinical or genetic variation.</p> <p>2. Categorize the changes in the metabolism for common diseases.</p> <p>3. Competently perform a series of fundamental biochemical techniques.</p> <p>4. Solve laboratory calculations for biomedical applications.</p> <p>5. Evaluate different choices of methods for biochemical laboratory work, and to plan, and to evaluate experiments.</p> <p>6. Outline the ethical and security issues in biomedical work.</p> <p>7. To develop a competent knowledge on latest advancements in Medical Biochemistry.</p>						
<b>Module:1</b>	<b>Methods for collection, handling and analysis of clinical samples</b>					<b>6 hours</b>
Blood, urine CSF, bile, biopsy specimens- Biochemical investigations and quality control, normal values and interpretation of results.						
<b>Module:2</b>	<b>Disorders of carbohydrate metabolism</b>					<b>6 hours</b>
Diabetes mellitus - acute and chronic complications, laboratory diagnosis and monitoring - Glycated Hb, Glucose tolerance test.						
<b>Module:3</b>	<b>Disorders of Lipid metabolism</b>					<b>6 hours</b>

Dyslipidemia - Hypo and hyperlipoproteinemias, Fatty liver, familial hypercholesterolemia, Cholesterol level in blood and atherosclerosis. Lipoidosis and xanthomatosis.			
<b>Module:4</b>	<b>Liver function tests &amp; interpretation</b>	<b>6 hours</b>	
Classifications of liver function tests- tests based on abnormal bile pigment metabolism, excretory function tests.			
<b>Module:5</b>	<b>Renal function tests &amp; interpretation</b>	<b>6 hours</b>	
Tests based on renal plasma flow, tubular function, glomerular filtration rate. Urea and insulin clearance tests.			
<b>Module:6</b>	<b>Gastric function tests &amp; interpretation</b>	<b>6 hours</b>	
Fractional test meal analysis, tubeless gastric analysis, stimulation tests			
<b>Module:7</b>	<b>Thyroid functioning tests and Recent advances in biochemical diagnosis</b>	<b>7 hours</b>	
Hyper and hypothyroidism tests measuring blood levels of thyroid hormone, immunological tests for thyroid function.			
<b>Module:8</b>	<b>Contemporary issues: Industry Expert Lecture</b>	<b>2 hours</b>	
		<b>Total Lecture hours:</b>	<b>45 hours</b>
<b>Text Book(s)</b>			
1.	Chatterjea M. N, Rana Shinde, Textbook Of Medical Biochemistry, 2012, 8th Edition, JAYPEE publication, INDIA		
<b>Reference Books</b>			
1.	Allan Gaw, Michael Murphy, Rajeev Srivastava, Robert A. Cowan, Denis St. J. O'Reilly, Clinical Biochemistry: An Illustrated Colour Text, 2013, 5th Edition, Elsevier Health publication - UK		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		03-08-2017	
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Course code	Course title	L	T	P	J	C
<b>BMG 6004</b>	<b>GENETIC ENGINEERING</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>4</b>
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
<ol style="list-style-type: none"> <li>1. Expose tools and strategies used in genetic engineering.</li> <li>2. Acquire knowledge about the concept of genetic engineering including the techniques, applications and limitations.</li> <li>3. Understand the applications of genetic engineering from academic and industrial perspective.</li> </ol>						
<b>Expected Course Outcome (CO):</b>						
<ol style="list-style-type: none"> <li>1. Describe the function of the most common enzymes and vectors used in genetic engineering.</li> <li>2. Attain a basic conceptual knowledge on different molecular techniques and when they would be applied</li> <li>3. Explain which biological hosts are the best choice for producing a certain protein and why</li> <li>4. Clone the gene of interest theoretically and manipulate the gene to be expressed in different host.</li> <li>5. Hypothesize how concepts in genetic engineering could be applied in their field of research</li> <li>6. Proficiency in designing and conducting experiments involving genetic manipulation.</li> </ol>						
<b>Module:1</b>	<b>Manipulation of DNA</b>	<b>7 hours</b>				
<b>Manipulation of DNA:</b> Restriction and modification enzymes, ligase, linker, adaptors, homopolymer tailing, Reverse transcriptase, <i>Taq</i> polymerase, DNA polymerase.						
<b>Module:2</b>	<b>Cloning vectors</b>	<b>7 hours</b>				
Characteristics of cloning and expression vectors based on plasmid, bacteriophage – lambda, M13 and Yeast.						

<b>Module:3</b>	<b>Blotting techniques</b>	<b>4 hours</b>
Southern, Northern and Western blotting; Dot and reverse blot.		
<b>Module:4</b>	<b>Techniques in Genetic engineering</b>	<b>8 hours</b>
PCR- basic reaction and types of PCR; DNA sequencing, Next generation sequencing, Microarray-based comparative genomic hybridization.		
<b>Module:5</b>	<b>Transformation and cloning strategies</b>	<b>6 hours</b>
Methods for gene transfer –chemical and physical methods. Cloning in Yeast, <i>B. subtilis</i> ; Genomic and cDNA Libraries.		
<b>Module:6</b>	<b>Reporter genes and Screening of recombinants</b>	<b>3 hours</b>
GFP, CAT, luciferase, colony hybridization, plaque lift techniques.		
<b>Module:7</b>	<b>Applications of r-DNA technology</b>	<b>8 hours</b>
Applications of r-DNA technology: Nucleic acid sequences as diagnostic tools- SNPs, VNTR, Genetic changes for over production of biomolecules such as insulin, interferon and growth hormones, Hazards and safety aspects of Genetic Engineering.		
<b>Module:8</b>	<b>Contemporary issues: Industry Expert Lecture</b>	<b>2 hours</b>
<b>Total Lecture hours:</b>		<b>45 hours</b>
<b>Text Book(s)</b>		
1.	Primrose SB and Old. Principles of Gene manipulation Blackwell Scientific Publications, 2015	
<b>Reference Books</b>		
1.	Terence A. Brown. Gene cloning and DNA analysis: an introduction, Wiley-Blackwell,2013	
2	M. R. Green, J. Sambrook. Molecular Cloning: A Laboratory Manual (Cold Spring Harbor, ed. 4, 2012).	
3	M. Wink. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology (Wiley, ed. 2, 2011)	

<b>List of Challenging Experiments (Indicative)</b>			
1.	Genomic DNA isolation from human sample and analysis	3 hours	
2.	Plasmid DNA Isolation and analysis	3 hours	
3.	Competent cell preparation	3 hours	
4.	Transformation and antibiotic selection or Blue white selection method	3 hours	
5.	Restriction digestion	3 hours	
6.	Ligation	3 hours	
7.	Polymerase chain reaction	3 hours	
8.	GFP Cloning	3 hours	
9.	Elution of DNA from agarose gel	3 hours	
10.	Non- Denaturing Poly Acrylamide Gel Electrophoresis	3 hours	
<b>Total Laboratory Hours</b>		<b>30 hours</b>	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
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Course code	Course title	L	T	P	J	C
<b>BMG6005</b>	<b>GENETIC COUNSELING</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>3</b>
<b>Pre-requisite</b>	<b>Clinical Cytogenetics and Prenatal Diagnosis</b>	<b>Syllabus version</b>				
		1.1				
<b>Course Objectives (CoB):</b>						
<ol style="list-style-type: none"> <li>1. To develop strong foundational knowledge and skills in genetic counseling encompassing medical genetics; psychological and ethical issues; and familial and social implications of genetic contributions to health and human disease.</li> <li>2. To build basic knowledge around the genetics of clinic and genetic guidance to be able to be aware of when and how patients should be referred further to genetic investigations.</li> <li>3. To extend the knowledge of different psychosocial and ethical aspects in connection with genetic guidance.</li> </ol>						
<b>Expected Course Outcome (CO):</b>						
<ol style="list-style-type: none"> <li>1. Analyze the various aspects of genetic counseling and the significance of genetic testing and screening procedure.</li> <li>2. Discuss how genetic diseases influence both individual and family as a society.</li> <li>3. Infer the knowledge around the genetics of clinic and genetic guidance to be able to be aware of when and how patients should be referred further to genetic investigations.</li> <li>4. Summarize the advanced knowledge of medical genetics and genomics; community genetics and genomics; clinical practice and genetic counseling skills; ethical, legal and social issues of genetic medicine.</li> <li>5. Elaborate the different genetic counseling process and the impact on families from a cultural, ethical and psychosocial perspective.</li> <li>6. Identify the potential for ethical challenges in emerging new genetic technologies.</li> </ol>						
<b>Module:1</b>	<b>Introduction of Genetic Counseling</b>	<b>4 hours</b>				
History and development of genetic counseling. Counseling Theory, Counseling Techniques, Lab genetic counseling. Group Dynamics: Theory and Application						
<b>Module:2</b>	<b>Invasive prenatal diagnostic techniques</b>	<b>4 hours</b>				

Indications for prenatal diagnosis, Techniques: amniocentesis, chorionic villus sampling, cordocentesis, placentocentesis. Comparative advantages, disadvantages and their importance for preventing chromosomal and gene abnormalities. Pseudomosaicism and Confined placental mosaicism.		
<b>Module:3</b>	<b>Noninvasive and Less invasive prenatal diagnostic techniques.</b>	<b>4 hours</b>
Noninvasive - Ultrasound, Embryoscopy, MRI, Less invasive - Prenatal screening for Down's syndrome and neural tube defect, Maternal screening (MSAFP patterns, triple test), detection of fetal blood cells and ffDNA in maternal blood. Preimplantation genetic diagnosis		
<b>Module:4</b>	<b>Pediatric genetic counseling</b>	<b>4 hours</b>
Diagnosis, management and genetic counseling for newborn multifactorial birth defects, multiple congenital anomalies, developmental delay, mental retardation, clinical syndromes, and single gene disorders; chromosome anomalies, neurological diseases, teratogenic effects, deformations and disruptions in the pediatric population.		
<b>Module:5</b>	<b>Reproductive genetic counseling</b>	<b>4 hours</b>
Normal and abnormal human embryonic development with emphasis on congenital malformations and birth defect syndromes. Role of teratogens in embryogenesis. Preconception and prenatal assessment of genetic risk and counseling. Reproductive Endocrinology and Infertility; female and male infertility; new reproductive technologies		
<b>Module:6</b>	<b>Cancer genetic counseling</b>	<b>4 hours</b>
Overview of medical oncology with an emphasis on familial and hereditary cancer. Genetic cancer risk assessment, clinical variability of cancer syndromes, diagnostic and presymptomatic molecular testing in hereditary cancer families; the indications, benefits and potential harm of testing. The application of contemporary genetics to cancer syndromes and sporadic cancer genetics evaluation and counseling.		
<b>Module:7</b>	<b>Adult genetic counseling and Psychological aspects of genetic counseling:</b>	<b>4 hours</b>
The genetic basis of psychiatric disorders and the relevance to clinical practice. Adult genetic counseling - diagnosis, management, and genetic counseling of individuals with adult-onset genetic disease, mental retardation and single gene disorders of the adult population, adult neurometabolic and neurologic disorders, Psychology of women, psychology of pregnancy, psychology of the family (family dynamics, therapy), mourning process, loss, influence of a handicapped child on the family, psychological aspects of infertility, adoption, use of psychodynamic theory of development		
<b>Module:8</b>	<b>Contemporary issues:</b>	<b>2 hours</b>
Industry expert lecture		
<b>Total Lecture hours:</b>		<b>30 hours</b>
<b>Project: "J Component"</b>		
<b>Text Book(s)</b>		
1.	Uhlmann WR, Schuette JL, Yashar B (2011). A Guide to Genetic Counseling. ISBN-10: 0470179651, ISBN-13: 978-0470179659, Wiley-Blackwell; 2 edition	
<b>Reference Books</b>		

1.	Corey, Gerald. (2013). Theory and practice of counseling and psychotherapy (8th ed.). Belmont, CA: Brooks/Cole (ISBN: 978-0840028549).		
2.	Patricia McCarthy Veach, Bonnie S. LeRoy, Dianne M. Bartels (2011). Facilitating the Genetic Counseling Process: A Practice Manual. Springer, ISBN: 0387003304, 9780387003306		
3.	Gladding, S. and Newsome, D. (2010) Clinical Mental Health Counseling in Community and Agency Settings (4rd Edition), NJ, Pearson		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		03-08-2017	
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Course code	Course title	L	T	P	J	C
<b>BMG6006</b>	<b>ETHICAL, LEGAL AND SOCIAL ISSUES IN GENETIC COUNSELING</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	Clinical Cytogenetics and Prenatal Diagnosis	<b>Syllabus version</b>				
<b>Course Objectives:</b>						
<ol style="list-style-type: none"> <li>To apply public health genetics within the context of law, ethics, and policy.</li> <li>To extend health services, environmental health, law, ethics, and socio-cultural aspects of public health genetics</li> <li>To evaluate genetic principles and genomic technologies in diagnosis, screening, and interventions for disease prevention and health promotion programs</li> </ol>						
<b>Expected Course Outcome:</b>						
<ol style="list-style-type: none"> <li>Summarize fundamentals of public health genetics</li> <li>Address ethical and legal implications in the use of genetic information and technologies in public health</li> <li>Identify gene interactions, environmental factors, behaviors, and race in health and disease</li> <li>Importance of ethical concepts</li> <li>Analysis of psycho-social aspects and clinical application of genomic technology</li> <li>Interpret the concept of ELSI in genetic counseling</li> </ol>						



<b>Module:1</b>	<b>Public health Genetics</b>	<b>8 hours</b>
<p>Historical perspectives on Public Health Genetics and ELSI. Eugenics, Newborn screening programs, special considerations in genetic testing children and adolescents, the nature and mission of genetic counseling, misattributed paternity and issues in DTC genetic testing. Community involvement in public health genetics.</p>		
<b>Module:2</b>	<b>Ethics in Genetic counseling</b>	<b>6 hours</b>
<p>Ethics and development. Ethical theories in the clinical, professional. Organizational and political-economic fields of action in health care. Professional codes of ethics. Bioethics - ethical theories and standards by health care professionals.</p>		
<b>Module:3</b>	<b>Bioethical principles and their applications</b>	<b>8 hours</b>
<p>Case management and genetic counseling, different types of ethical dilemmas and alternative ways of handling them morally. Issues include euthanasia, assisted suicide, truth-telling, confidentiality, research ethics, abortion, genetic counseling, surrogate motherhood, the uses of new reproductive technologies, and justice with respect to care.</p>		
<b>Module:4</b>	<b>Global Health and Ethics</b>	<b>6 hours</b>
<p>Ethical issues in global health, fundamental ethical issues about health prospects of population-the natural world, the global economy, war and international aid. Ethical issues about trade in human organs, infectious diseases, human migration, sustainable development, malnutrition, and care of the elderly, health inequalities within and between countries, nutrition, war, environmental degradation.</p>		
<b>Module:5</b>	<b>Genetics and racial disparities</b>	<b>4 hours</b>
<p>Identifying racial and ethnic differences in genetic risk factors. Using genetics to address health disparities. Ethical, legal, and social issues involved in using genetics to address</p>		
<b>Module:6</b>	<b>Ethical concepts</b>	<b>3 hours</b>
<p>Related to responsibility, need, autonomy, community, human rights, and global justice. Genetic discrimination and genetic exceptionalism</p>		
<b>Module:7</b>	<b>Psychosocial Aspects of Genetic Counseling</b>	<b>8 hours</b>
<p>Exploration of the impact of genetic knowledge/conditions on the individual and family. Human development and the theoretical underpinnings of various counseling models and psychotherapy, related to genetic counseling. Specific techniques of the counseling process, including the rationale for the technique, the timing of the technique and the evaluation of the technique. The</p>		

biopsychosocial assessment, with an appreciation of the function of race, gender, social class and sexual orientation in human behavior. Contemporary Issues in Genetics and Society - Genetics and law - human subject research and the limits, regulations, protection of vulnerable populations, research on children, role of the IRB in the review of human subjects research, bio banking, research on stored tissues and data, the Human Genome Diversity Project. Commercialization of genetic research and genetic patents; gene transfer research. The future of Genetics: science and society. Genomic advances in personal and professional life.

<b>Module:8</b>	<b>Contemporary issues:</b> Industry expert lecture	<b>2 hours</b>
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	<b>Total Lecture hours:</b>	<b>45 hours</b>
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**Text Book(s)**

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| 1. | Uhlmann WR, Schuette JL, Yashar B (2009). A Guide to Genetic Counseling. ISBN-10: 0470179651, ISBN-13: 978-0470179659, Wiley-Blackwell; 2 edition. |
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**Reference Books**

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|----|---|
| 1. | Francis S. Collins , The Language of Life: DNA and the Revolution in Personalized Medicine.2011, Harper Perennial Publishers. |
| 2. | David L. Rimoin, Reed E. Pyeritz, Bruce Korf (2013). Emery and Rimoin's Essential Medical Genetics Elsevier.                  |
| 3. | ICMR Guidelines-Ethics, Prenatal diagnosis  |

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

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<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>J</b>	<b>C</b>
<b>BMG6007</b>	Clinical Rotation	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>2</b>
<b>Pre-requisite</b>	Clinical Cytogenetics and Prenatal Diagnosis	<b>Syllabus version</b>				
<b>Course Objectives:</b>						
1. To observe in a variety of genetic counseling settings to begin to integrate academic knowledge into clinical settings.						
2. To understand the medical and psychosocial implications of genetic disorders						
<b>Expected Course Outcome:</b>						
1. Elaborate on the various aspects of genetic counseling and its influence in genetic testing						
2. Summarize the clinical practice and genetic counseling skills; ethical, legal and social issues of genetic medicine						
<b>Module:1</b>	Clinical training for atleast 12 weeks	<b>100 hours</b>				
1. First year – First semester end – December (4 weeks)						
2. First year – Second semester end – June (4 weeks)						
3. Second year – Third semester end – December (4 weeks)						
4. Specialty Clinics and clinical genetic settings – Pediatric hemato-oncology, Speech, hearing and language, Child development (Pediatrics), Neonatology, Urology, Obstetrics and Gynaecology, Human Genetics, Pathology, Radiology, SMART, Clinical psychology and Genetic Diagnostics.						
5. Students will submit a write-up of their observations at the end of the program						

6. Attendance will be taken for the students for the duration of the program			
Mode of Evaluation:			
1. An oral defense and research project to be completed			
2. Supervision with Program faculty			
Recommended by Board of Studies	03-08-2017		
Approved by Academic Council	No. 46	Date	24-08-2017