M.Sc., BIOMEDICAL SCIENCE

5 Year Integrated Programme
(5PSBMS)

REGULATIONS
&
CURRICULUM STRUCTURE
(Academic Year 2022-23 onwards)
(Revised on 10.05.2024)

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BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI – 620 024

M.Sc., BIOMEDICAL SCIENCE (5 YEAR INTEGRATED) PROGRAMME

PREAMBLE OF THE COURSE STRUCTURE

(M.Sc. Biomedical Science - Integrated Programme)

PROGRAMME: M.Sc. Biomedical Science (5 year Integrated) is an autonomous programme through Choice Based Credit System [CBCS] offered by the Department of Biomedical Science, Bharathidasan University, Tiruchirappalli. It will be an intensive full time 5 years course, which will include classroom lectures, seminars, guest lectures, laboratory practical, and projects. Equip young students with in-depth education, highly skilled and strategies to change the future of modern medicine. Our Ultimate aim is to promote, develop and deliver excellence in all aspects of biomedical science. In this Programme, the candidates will have proper guidance and support to set quality standards for the health care profession through training, education, assessments, examinations and continuous professional development.

DURATION OF THE PROGRAMME: The period of certified study for the M.Sc, Biomedical Science (5 year Integrated Programme) shall be a full time course and its duration shall extend over a period of five academic years consisting 10 semesters pattern, with examinations at the end of each semester. Each year shall consist of two semesters" viz. Odd and Even semesters. Odd semester shall be from July to November and even semester shall be from December to April. There shall be not less than 90 working days which shall comprise 450 teaching clock hours for each semester.

ELIGIBILITY FOR ADMISSION: A candidate who has passed in Higher Secondary School Examination (10+2 Pattern) conducted by State Governments / CBSE or an equivalent examination of other Board accepted by the Syndicate of this University, as equivalent thereto are eligible for admission. This program will be offered to students who have completed their 12 years of schooling and studied Biology, Physics and Chemistry through their $10^{th,}$ 11th and 12th standards. Students who have also had Mathematics besides Biology would be considered too. Candidate must have minimum pass grade or equivalent and as per Government norms.

Students for this program would be selected based on the aggregated average of the performance of the candidate in their Higher Secondary School Examination and also through the Entrance test / Counselling conducted by the Department for this purpose, if necessary. On the basis of the performance in the marks secured in +2, and the entrance test, the candidates will be short-listed for admission. The performance in the entrance test / +2 marks, evidence of age, educational qualification, community, extra-curricular activities, etc., will be verified during the admission time. The Tamil Nadu Government norms will be applied in the selection of candidates. The list of candidates who are selected will be displayed in the notice board of the Department and University website. Official letter of intimation will also be sent to the selected candidates.

EXAMINATIONS: There shall be examination at the end of each semester: for odd semesters in the month of October / November and for even semester in the month of April/May. During X semester students has to undergo four-six months dissertation work followed by viva-voce Examination, in addition to other courses. The students has the option of undergoing final year project at other Universities/National Research Laboratories with the permission of Head of the Department.

CREDITS: Credit is a system of quantifying the outcomes of learning or means of expressing equivalence of learning. It is way of comparing learning achieved using different parameters such as student work load, learning out comes and contact hours. At the global level there are two method of assigning credits "Credits" may be calculated my means of „learning outcomes" or „contact hours". Total Credits for M.Sc., 5 year integrated program is minimum 230 credit requirement.

EXIT OPTION: It is proposed that students of 5-year Integrated Biomedical Science Programme have the option of exit at the end of the third-year with a B.Sc. degree in Biomedical Science, by fulfilling minimum 140 credit requirements specified in the M.Sc. Biomedical Science course structure. A duly constituted departmental committee will review the student"s request for lateral exit and the Committee"s recommendations will be forwarded to the Head of the Institution for the final approval.

ELECTIVE COURSE AND EXTRA DISCIPLINARY COURSES (ECs & EDCs): Normally for science students the Major Elective Courses (EC) shall be chosen within those offered by the Science groups. The Extra Disciplinary course (EDC) are open to all students irrespective of Science or Arts or Commerce Programs.

GRADING: Once the marks of the CIA and end-semester examinations for each of the courses are available, they will be added. The marks, thus obtained will then be graded as per the scheme provided in Table 3. From the second semester onwards the total performance within a semester and continuous performance starting from the first semester are indicated respectively by Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA). These two are calculated by the following formulae (Equation-1):

$$GPA = \frac{\sum_{i=1}^{n} CiGi}{\sum_{i=1}^{n} Ci}$$

Equation-1

Where „Ci" is the Credit earned for the Course I in any semester; „Gi" is the Grade Point obtained by the student for the Course I and „n" is the number of Courses passed in that semester.

CGPA = Cumulative Grade Point Average (Average Grade Points of all the Courses passed starting from the first semester to the current semester.)

ATTENDANCE: As prescribed by the University from time to time. As of now, each student should earn a minimum of 80% of attendance to appear for the University Examinations.

EVALUATION SYSTEMS: Evaluation of each theory and project course shall comprise of Continuous Internal Assessment (CIA) for 25 marks and 75 marks for End Semester Examinations (ESE). For Practical examination: Evaluation of each practical course shall comprise of Continuous Internal Assessment (CIA) for 40 marks and 60 marks for End Semester (practical) examinations (ESE).

QUESTION PAPER PATTERN:
UNIVERSITY SEMESTER EXAMINATION (THEORY):

Part-A	Answer all questions	15X1= 15 Marks
Part-B	Answer any 5 questions out of 6 questions	5X03 = 15 Marks
Part-C	Answer any 5 questions out of 6 questions	5X05 = 25 Marks
Part-D	Answer any 2 questions out of 4 questions	2X10= 20 Marks
	Total	75 Marks

a. **CIA marks:** The CIA marks are awarded by based on student"s academic performance in each paper. The pattern may followed as given below

Unit test	10
Seminar	05
Assignment	05
University Model Exam	05
	25

(OR)

The concerned course teacher has the liberty to design the pattern. The CIA will be conducted by the Dept. of Biomedical Science, Bharathidasan University

b. **ESE:** There will be two methods of evaluation:

a). The External examination will be conducted by the University at the end of each semesters in subjects mentioned.

b). Project evaluation will consist of Presentation of their research findings and should defend their dissertation work which will be conducted by the University in the Department of Biomedical Science, Bharathidasan university.

UNIVERSITY SEMESTER EXAMINATION (PRACTICAL):

The examiners will be appointed by HOD on the basis of the recommendations of the board of studies. The maximum marks for each practical examination will be 100 marks.

MAXIMUM MARKS:

Maximum marks will be 100 for each theory paper and practical. The maximum marks for M.Sc., project/dissertation work shall be 200.

PASSING MINIMUM:

Theory : A student is declared to have passed in each theory course if he/she secures not less than 40% marks (30 marks out of 75) in University Examination and 40% marks (10 marks out of 25) in CIA and not less than 50% marks in aggregate taking CIS and University Exam marks together.

Practical : A student is declared to have passed in each theory course if he/she secures not less than 40% marks (24 marks out of 60) in University Examination and 40% marks (16 marks out of 40) in CIA and not less than 50% marks in aggregate taking CIS and University Exam marks together.

For Arrear Candidates: A candidate who does not pass the subject(s) may be permitted to reappear in such subject(s) in the subsequent examination to be held in October/November or April/May. However, candidates who have arrear in practical/lab shall be permitted to take

their arrear practical/lab examinations only along with regular practical examination(s) in the respective semesters.

NUMBER OF WORKING DAYS PER SEMESTER

No. of working days - 90
Last working day & exam schedule will be planned suitably.

COMMUTATION OF MARKS INTO GRADES AND NORMALIZATION- AS PER THE UNIVERSITY PATTERN: The marks to grade conversion are as follows: **TABLE-1**

Marks Range	**Corresponding Grade**	**Grade points**
90 and above	O	10
80 and above but below 90	A^+	9
70 and above but below 80	A	8
60 and above but below 70	B^+	7
50 and above but below 60	B	6
Below 50	RA	NA
Absent / withdrawn	AAA	NA
Redo (For want of Attendance)	Z	NA

- The various grades shall be as follows: O, A+, A, B+, B & RA (Reappearance; option only for core, for electives, the candidate may either reappear or choose alternative elective papers).
- The student who fails in one or more theory papers will be permitted to reappear for the same again in the subsequent semesters.
- Those who fail in the lab course will be permitted to reappear for the same along with the next following regular batch of students, in the concerned semester.
- A candidate who fails in the project / related field training examinations will have to redo the same in a subsequent semester and appear for the examination at the end for the semester.

PRACTICAL /SUMMER TRAINING: Student may undergo practical/summer/Internship training during the months of May and June. The student should submit a report singed by the supervisor from the industry/Institution involved in Biomedical Sciences, in which he/she has undertaken the training.

GUIDELINES FOR FINAL SEMESTER PROJECT/DISSERTATION: Each M.Sc., student will have to undertake a project work under the guidance of his/her supervisor for a period of 4-6 months as per course curriculum. The students will have the option of undertaking the project work in the Department Laboratory itself or in other Institutions based on permission of HOD. The Department faculty members act as an Internal Supervisor for the student who are doing dissertation in other institutes. Also, those students are advised to submit their Joining report duly signed by their external guide from the host institute at earliest (within 2 weeks) possible to their internal guide

OBJECTIVE OF DISSERTATION: To impart the theoretical knowledge through research methods may help those to formulate a rigorous research problem related to basic medical science on the basis of their observation form their experiments. This will help to do an independent study and encourage them to answer a scientific question

SUBMISSION OF DISSERTATION: The student will be allowed to submit his/her thesis once the supervisor (Internal/External) is satisfied with the progress and completion of the research work. The project work should be an original research.

ORAL DEFENSE OF THE DISSERTATION/THESIS: The student will have to defend his/her research work in front of a panel consisting internal examiner and an external examiner appointed by the HOD.

FINAL CONFERMENT OF THE DEGREE: A candidate shall be declared eligible for conferment of the degree only after he/ she has passed all the courses prescribed therefore, including practical/ labs and project/ dissertations.

RANKING: A candidate who passes all courses in the prescribed period of duration of the course in the first appearance in all the papers and also scores the highest total marks, is alone eligible for ranking.

- Reappeared candidates will not be considered for ranking.
- Only one rank will be considered for each core Department.
- Student‟s strength of the course will be indicated in the Rank Certificate.

REVISION OF REGULATION AND CURRICULUM: The Department Board of Studies (BOS) may, from time to time, revise, amend or change the Regulations and the curriculum, if found necessary. However, the Department follows other general guidelines of the University, which are not laid down in this regulation

AMENDMENT OF RULES: The Department committee may be empowered to change/modify the regulations relating to M.Sc (Biomedical Science) program as and when required.

OTHER REGULATIONS:

1. The Department committee may be empowered to implement the orders of University.
2. The common regulations of the University shall also be applicable to this program.
3. The dress should be clean Trousers and Collared Shirt for Boys; Salwar or Churidhar with Kameez for Girls and student maintain decorum.
4. All students are requested to hold their university identity card while entering into the department
5. Wearing Lab coat and laboratory shoes (Exception wherever applicable, E.g. Animal tissue culture facility) are mandatory for all students during the practical hours. The details regarding the lab coat patterns can be obtained from department office.
6. Students are advised to contact their respective academic councilors /coordinator for any queries and further assistance.
7. All students are requested to keep their department premises very neat and clean
8. The department library facility is available for students convince. All students are advised to utilize library facility and strictly follow the library regulation and rules.

9. All students are advised to make entry in log book, while using the instruments in the lab.
10. Using mobile phones inside the class rooms/Laboratory are strictly prohibited
11. The students are requested to provide their Parents/Guardians contact address with telephone numbers to their respective academic councilors. The change of address and contact numbers need to be informed immediately. The same way parents are requested to contact the academic councilors contact details on each year to know the wards overall performance in the Department
12. The Department has constituted anti ragging / sexual harassment committee. The committee members contact details and numbers are available in the Department notice board.

CURRICULUM STRUCTURE (TABLE 2)

S.No.	Part	Type of the Course	Number of Courses	Total Credits
1	I	Languages	4	12
2	II	General English	4	12
3	III	A. Allied Courses I & II	4	20
		B. Core Courses	18	90
		C. Core Choices Courses	3	15
		D. Entrepreneurship/Industry Based Course	1	4
		E. Laboratory Courses	9	27
		F. Elective Courses	3	12
		G. Skill Based Elective Courses	2	10
		H. Non-Major Elective Courses	4	8
		I. Project	2	10
4	IV	A. Value Education	1	2
		B. Environmental Studies	1	2
		C. Soft Skills	1	2
5	V	A. Extension Activities	1	2
		B. Gender Studies	1	2
		Total	**59**	**230**
		C. Value Added Course	2	4

BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI 620 024
M.Sc., BIOMEDICAL SCIENCE - 5 YEAR INTEGRATED
PROGRAMME STRUCTURE UNDER C.B.C.S*.
(Application to the candidates admitted from the year 2022 onwards)

FIRST YEAR - I SEMESTER

Part	Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
					CIA	ESE	Total
I	CL01 **BM11TL1A/ BM11FL1**	Language Course I- Tamil/ French	3	5	25	75	100
II	GEC01 **BM11EL1**	Language Course I – English	3	5	25	75	100
III	CC01 **BM11C1**	Core Course -1 : Cell Biology	5	5	25	75	100
	LC01 **BM11CP1**	Laboratory Course 1: Cell Biology	3	4	40	60	100
	AICC01 **BM11AC1**	Allied Course-1: Mathematics	5	5	25	75	100
IV	VE **BM11VE**	Value Education : Men and Society	2	3	25	75	100
		Seminar, Library, Leveraging E-Resources, VAC, etc.	--	3	--	--	--
		Total	**21**	**30**	**165**	**435**	**600**

FIRST YEAR - II SEMESTER

Part	Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
					CIA	ESE	Total
I	CL02 **BM12TL2A/ BM12FL2**	Language Course II- Tamil/ French	3	5	25	75	100
II	GEC02 **BM12EL2**	Language Course II – English	3	5	25	75	100
III	CC02 **BM12C2**	Core Course -2: Human Anatomy and Physiology	5	5	25	75	100
	LC02 **BM12CP2**	Laboratory Course -2: Human Anatomy and Physiology	3	4	40	60	100
	AICC02 **BM12AC2**	Allied Course-2: Chemistry	5	5	25	75	100
IV	ES01 **BM12ES**	Environmental Studies	2	3	25	75	100
		Seminar, Library, Leveraging E-Resources, VAC, etc.	--	3	--	--	--
		Total	**21 (42)**	**30**	**165**	**435**	**600 (1200)**

SECOND YEAR - III SEMESTER

Part	Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
					CIA	ESE	Total
I	CL03 **BM23TL3A/ BM23FL3**	Language Course III- Tamil/ French	3	5	25	75	100
II	GE03 **BM23EL3**	Language Course –III English	3	5	25	75	100
III	CC03 **BM23C3**	Core Course -3: Biochemistry	5	5	25	75	100
	LC03 **BM23CP3**	Laboratory Course 3: Biochemistry	3	4	40	60	100
	AIICC01 **BM23AC3**	Allied Course - 3: Physics	5	5	25	75	100
IV	NMEC01 **BM23NM1/ BM23NM3**	Non-Major Elective Course-1#	2	3	25	75	100
		Seminar, Library, Leveraging E-Resources, VAC, etc.	--	3	--	--	--
		Total	**21 (63)**	**30**	**165**	**435**	**600 (1800)**

Offered to other Department Students

SECOND YEAR - IV SEMESTER

Part	Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
					CIA	ESE	Total
I	CL04 **BM24TL4A/ BM24FL4**	Language Course IV-Tamil/ French	3	5	25	75	100
II	GEC04 **BM24EL4**	Language Course IV- English	3	5	25	75	100
III	CC04 **BM24C4**	Core Course -4: Principles of Genetics	5	5	25	75	100
	AIICC02 **BM24AC4**	Allied Course -4: Microbiology	5	5	25	75	100
	AIILC01 **BM24AP1**	Laboratory Course 4: Microbiology	3	4	40	60	100
IV	NMEC02 **BM24NM2/ BM24NM4**	Non-Major Elective Course-2#	2	3	25	75	100
V	EA01 **BM24EA**	Extension Activities (Field Visit / Medical Awareness Camp)	2	--	100	--	100
		Seminar, Library, Leveraging E-Resources, VAC, etc.	--	3	--	--	--
		Total	**23 (86)**	**30**	**265**	**435**	**700 (2500)**

Offered to other Department Students

THIRD YEAR - V SEMESTER

Part	Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
					CIA	ESE	Total
III	CC05 **BM35C5**	Core Course - 5: Molecular Biology	5	5	25	75	100
	CC06 **BM35C6**	Core Course - 6: Immunology	5	5	25	75	100
	CC07 **BM35C7**	Core Course - 7: Pharmacology and Toxicology	5	5	25	75	100
	LC04 **BM35CP4**	Laboratory Course-5: Molecular Biology	3	4	40	60	100
	SEC01 **BM35S1BT/ BI**	Skill Based Elective Course-1: (Biotechniques / Bioinformatics)	5	5	25	75	100
	CP01 **BM36P1**	Project -I	--	2	--	--	--
IV	SK01 **BM35SK**	Soft Skills	2	2	100	--	100
V	GS01 **BM35GS**	Gender Studies	2	2	100	--	100
		Total	**27 (113)**	**30**	**340**	**360**	**700 (3200)**

THIRD YEAR - VI SEMESTER

Part	Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
					CIA	ESE	Total
III	CC08 **BM36C8**	Core Course- 8: Biotechnology	5	5	25	75	100
	CC09 **BM36C9**	Core Course -9 : Clinical Microbiology	5	5	25	75	100
	CC10 **BM36C10**	Core Course- 10 : Human Pathology	5	5	25	75	100
	LC05 **BM36CP5**	Laboratory Course 6: Clinical Pathology	3	4	40	60	100
	SEC02 **BM36S2ML/ FS**	Skill Based Elective Course-2: (Medical Laboratory Techniques / Forensic Science)	5	5	25	75	100
	CP01 **BM36P1**	Project -I	4	6	40	60	100
		Seminar, Library, Leveraging E-Resources, VAC, etc.	--	--	--	--	--
		Total	**27(140)**	**30**	**180**	**420**	**600 (3800)**

(Students should earn minimum of 140 credits for their BSc., Biomedical Science)

FOURTH YEAR - VII SEMESTER

Part	Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
					CIA	ESE	Total
III	CC11 **BM47C11**	Core Course -11: Clinical Biochemistry	5	6	25	75	100
	CC12 **BM47C12**	Core Course -12: Genomics	5	6	25	75	100
	CO01 **BM47C13 P/A**	Core Choices Course: 1 Proteomics / Advanced Molecular Biology	5	5	25	75	100
	EC01 **BM47E1 C/R**	Elective Course -1: Cell Signaling / Reproductive Biology and Health	4	5	25	75	100
	LC06 **BM47CP6**	Laboratory Course 7: Clinical Biochemistry	3	5	40	60	100
V		Seminar, Library, Leveraging E-Resources,etc. (**VAC**)**	--	3	--	--	--
		Total	**22 (162)**	**30**	**140**	**360**	**500 (4300)**

FOURTH YEAR - VIII SEMESTER

Part	Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
					CIA	ESE	Total
III	CC13 **BM48C14**	Core Course -13: Genetic Engineering	5	5	25	75	100
	CC14 **BM48C15**	Core Course -14: Immune and Molecular Diagnostics	5	5	25	75	100
	CO02 **BM48C16 N/M**	Core Choices Course: 2 Neurobiology / Molecular Medicine	5	5	25	75	100
	EC02 **BM48E2S/ D**	Elective Course-2: Social and Preventive Medicine / Drug Discovery and Assay Development	4	5	25	75	100
	LC07 **BM48CP7**	Laboratory Course-8: Immune and Molecular Diagnostics	3	5	40	60	100
	NMEC01	Non-Major Elective Course-3#	2	3	25	75	100
V		Seminar, Library, Leveraging E-Resources, etc. (**VAC**)***	--	2	--	--	--
		Total	**24 (186)**	**30**	**165**	**435**	**600 (4900)**

(offered by Other Department)

FIFTH YEAR - IX SEMESTER

Part	Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
					CIA	ESE	Total
III	CC15 **BM59C17**	Core Course-15: Stem Cell Biology and Regenerative Medicine	5	5	25	75	100
	CC16 **BM59C18**	Core Course-16: Cancer Biology	5	5	25	75	100
	CO03 **BM59C19 MG/MV**	Core Choices Course:3 Medical Genetics / Medical Virology	5	5	25	75	100
	EC03 **BM59E3 SC/RM**	Elective Course-3: Scientific Writing and Communication / Research Methodology and Biostatistics	4	5	25	75	100
	LC08 **BM59CP8**	Laboratory Course-9: Cell Culture Techniques	3	5	40	60	100
	NMEC02	Non-Major Elective Course-4#	2	3	25	75	100
	CP02 **BM510P2**	Project -II	--	2	--	--	--
		Seminar, Library, Leveraging E-Resources, VAC, etc. (Industrial / Field Visit)	--	--	--	--	--
		Total	**24(210)**	**30**	**165**	**435**	**600 (5500)**

(offered by Other Department)

FIFTH YEAR - X SEMESTER

Part	Course Code	Name of the Course	Credits	Teaching Hours	Maximum Marks		
					CIA	ESE	Total
III	CC17 **BM510C20**	Core Course -17: Nanomedicine	5	5	25	75	100
	CC18 **BM510C21**	Core Course- 18: Biosafety, Bioethics and IPR	5	5	25	75	100
	EIBC01 **BM510EIB1**	Entrepreneurship/Industry Based Course: Entrepreneurship in Biomedical Science	4	5	25	75	100
	CP02 **BM510P2**	Project-II	6	15	50	150	200
		Seminar, Library, Leveraging E-Resources, VAC, etc.	--	--	--	--	--
		Total	**20**	**30**	**125**	**375**	**500**
		Overall Total	**230**	**300**	**1875**	**4125**	**6000**

DISTRIBUTION OF CREDITS (TABLE 3)

Course	S.No.	SEMESTER	CREDITS		HOURS/W	
			T	P	T	P
M.Sc., Biomedical Science (5 Year Integrated Programme)	1	I	18	3	26	4
	2	II	18	3	26	4
	3	III	18	3	26	4
	4	IV	20	3	26	4
	5	V	24	3	26	4
	6	VI	24	3	26	4
	Total		**122 + 18= 140***		156 + 24 = 180	
	7	VII	19	3	25	5
	8	VIII	21	3	25	5
	9	IX	21	3	25	5
	10	X	20	0	30	0
	Total		81 + 9= 90*		105 + 15= 120	
	TOTAL		**140 + 90 = 230***		180 + 120= 300	
Total			230		300	

* Students should earn minimum of **140** credits for their **BSc., Biomedical Science** and minimum of **230** credits for their Integrated **M.Sc., Biomedical Science** program.

NME (Offered to Other Department)

S.No	Course	Course Code	Semester	Marks			Hrs/ Week Theory	Credits
				CIA	ESE	TOTAL		
1	Immunology	BM23NM1	ODD	25	75	100	3	2
2	Medical Genetics	BM23NM3	ODD	25	75	100	3	2
3	Human Pathology	BM24NM2	EVEN	25	75	100	3	2
4	Forensic Science	BM24NM4	EVEN	25	75	100	3	2

**VALUE ADDED COURSES (ODD SEMESTER)

S.No	Course	Course Code	Semester	Marks			Hrs/ Week Theory	Credits
				CIA	ESE	TOTAL		
1	Principles of Nutrition	BM47VAC1	ODD	25	75	100	3	2
2	Health and Hospital Management	BM47VAC2	ODD	25	75	100	3	2

*****VALUE ADDED COURSES (EVEN SEMESTER)**

S.No	Course	Course Code	Semester	Marks			Hrs/ Week Theory	Credits
				CIA	ESE	TOTAL		
1	Nutritional Biochemistry	BM48VAC3	EVEN	25	75	100	2	2
2	Clinical Data Analysis	BM48VAC4	EVEN	25	75	100	2	2
3	Medical Coding	BM48 VAC5	EVEN	25	75	100	2	2

Programme Outcomes

1. PG Graduands will be Professionally Competent with characteristic Knowledge-bank, Skill-set, Mind-set and Pragmatic Wisdom in their chosen fields.
2. PG Graduands are able to demonstrate the desired sense of being seasoned and exhibit unequivocal Spiritedness with excellent qualities of productive contribution to society and nation in the arena Science and Technology.
3. PG Graduands are mentored such that they exert Leadership Latitude in their chosen fields with commitment to novelty and distinction.
4. PG Graduands are directed in understanding of ethical principles and responsibilities, moral and social values in day-to-day life thereby attaining Cultural and Civilized personality.
5. PG Graduands of are able to Collate information from different kinds of sources and gain a coherent understanding of the subject

Programme Specific Outcomes:

1. Biomedical Post graduates have in-depth knowledge to compete National Level Eligibility Tests to procure various research fellowships to set up their research career.
2. Students acquire skills in specific field and generate new scientific insights to compete with International students.
3. Nevertheless, they qualify other competitive exams like State level TNPSC and National Level UPSC exams in addition to their scientific talents.
4. Students acquire specific skills in using computer based tools to carry out scientific investigations and get placed as Medical transcriptionist and R & D based laboratories.
5. Students are skilled enough in planning and carrying out experiments and solve scientific problems by combination of theoretical and practical knowledge.
6. Students demonstrate high experimental skills to qualify for various diagnostic laboratories and multispecialty hospitals.
7. Students are equipped to start their own business (Entrepreneurs) in the field of Pharmaceutical and Medical Biotechnology.

8. Students acquire teaching and Laboratory management skills, who inclined to get into Teaching profession and Lab Manager Position.
9. Students demonstrate multidisciplinary skills suitable enough to compete globally to satisfy scientific demands in basic and clinical studies, without compromising scientific ethics.
10. Students acquire skills to write scientific literature enabling them to get placed in scientific publishing concerns.

Code System

BM11TL1 – „BM" –

Biomedical BM12C2 –

„12" – 1 Year 2 Semester

BM11C1– „C" – Type of the course (**C** – Core; **E** – Elective; **TL**-Tamil Language; **FL**-French Language; **AC** – Allied; **NM** – Non-Major Elective; **ES**- Environmental Science; **S** – Skill based studies; **EA**- Extension Activities; **GS**-Gender Studies; **SK**-Soft Skill; **VE** – Value Education; **P** – Project; **VAC**-Value Added Course; **EIB**- Entrepreneurship/Industry Based Course)

BM12C2 – „2" – Sl. No. of the Course

Other Abbreviations

L - Lecture **T/P** - Tutorial/Practical **CIA** - Continuous Internal Assessment **ESE** - End Semester Examination

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M. Sc., Biomedical Science

5 Year Integrated Programme

(5PSBMS)

SYLLABUS

பொதுத்தமிழ்-1

தமிழ் இலக்கிய வரலாறு -1

முதலாம் ஆண்டு – முதற் பருவம்

Course Code	Course Name	category	L	T	P	S	Credits	Ins.Hrs	CIA	External	Total
BM11TL1A	பொதுத்தமிழ் -1 தமிழ் இலக்கிய வரலாறு -1	Supportive	Y	-	-	-	3	6	25	75	100
Pre-Requisite		பன்னிரெண்டாம் வகுப்பில் தமிழை ஒரு பாடமாகப் பயின்றிருக்க வேண்டும்							SV 2023		

Learning Objectives

- முதலாமாண்டுப் பட்ட வகுப்பு மாணவர்களுக்குத் தமிழ் மொழி இலக்கியங்களை அறிமுகம் செய்தல்
- தமிழ் இலக்கியப் போக்குகளையும், இலக்கணங்களையும் மாணவர் அறியுமாறு செய்து அவர்களின் படைப்பாற்றலைத் தூண்டுதல்
- தமிழ் இலக்கியம் சார்ந்த போட்டித் தேர்வுகளுக்கு ஏற்ப கற்பித்தல் நடைமுறைகளை மேற்கொள்ளுதல்

Expected Course Outcomes

On the Sucessful completion of the Course, Students will be able to

இப்பாடத்தைக் கற்பதால் பின்வரும் பயன்களை மாணவர் அடைவர்

CO 1	சங்க இலக்கியத்தில் காணப்பெறும் வாழ்வியல் சிந்தனைகளை அறிந்து கொள்வர்	K4
CO 2	அற இலக்கியம் மற்றும் தமிழ் காப்பியங்களின்வழி வாழ்வியல் சிந்தனையைப் பெறுவர்	K5, K6
CO 3	பக்தி இலக்கியங்களைக் கற்பதன் மூலம் பக்தி நெறியினையும், பகுத்தறிவு இலக்கியங்களைக் கற்பதன் வழி நல்லிணக்கத்தையும் தெரிந்து பின்பற்றுவர்	K3
CO 4	மொழியறிவோடு சிந்தனைத்திறனைப் பெறுவர்	K3
CO 5	மொழிப்பயிற்சிக்குத் தேவையான இலக்கணங்களைக் கற்பர்.	K2

K1 - Remember; K2 - Undestand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

அலகு-1	தமிழ் இலக்கிய, இலக்கண வரலாறு அறிமுகம்.

1. இலக்கணம்;

அ.தொல்காப்பியம், இறையனார் களவியல் உரை , நம்பியகப் பொருள், புறப்பொருள் வெண்பா மாலை, நன்னூல், தண்டியலங்காரம், யாப்பருங்கலக்காரிகை- நூல்கள்

ஆ.மொழிப் பயிற்சி- ஒற்றுப்பிழை தவிர்த்தல்

- வல்லினம் மிகும் இடங்கள்
- வல்லினம் மிகா இடங்கள்
- ஈரொற்று வரும் இடங்கள்
- ஒரு, ஓர் வரும் இடங்கள்
- அது, அஃது வரும் இடங்கள்
- தான், தாம் வரும் இடங்கள்

பயிற்சி : வல்லினம் மிகும் இடங்கள், மிகா இடங்கள் தவறாக வரும்வகையில் ஒரு பத்தி கொடுத்து ஒற்றுப் பிழை திருத்தி எழுதச் செய்தல்.

2. சங்க இலக்கியம் - எட்டுத்தொகை, பத்துப்பாட்டு
3. அற இலக்கியம்-பதினெண்கீழ்கணக்கு நூல்கள்
4. காப்பிய இலக்கியம் - ஐம்பெருங் காப்பியங்கள், ஐஞ்சிறு காப்பியங்கள், சமயக் காப்பியங்கள்
5. க்தி இலக்கியமும் (பன்னிரு திருமுறைகள், நாலாயிர திவ்வியப் பிரபந்தம் -- பகுத்தறிவு இலக்கியமும் (சித்தர் இலக்கியங்கள், புலவர் குழந்தையின் இராவண காவியம்)

அலகு-2	சங்க இலக்கியம்

எட்டுத்தொகை ;எ

1. நற்றிணை-முதல் பாடல் -நின்ற சொல்லர்
2. குறுந்தொகை 3 ஆம் பாடல் -நிலத்தினும் பெரிதே
3. ஐங்குறுநூறு –நெல் பல பொலிக! பொன் பெரிது சிறக்க!' (முதல் பாடல்)-வேட்கைப் பத்து
4. கலித்தொகை- 51 - சுடர்த்தொடீஇக் கேளாய் -குறிஞ்சிக் கலி
5. புறநானூறு -189 தெண்கடல் வளாகம் பொதுமையின்றி, நாடா கொன்றோ -187

பத்துப்பாட்டு;

1. முல்லைப்பாட்டு (முழுவதும்)

அலகு-3	அற இலக்கியம்

1.திருக்குறள் -அறன் வலியுறுத்தல் அதிகாரம்

2.நாலடியார்-பாடல்: 131 (குஞ்சியழகும்)

3.நான்மணிக்கடிகை-நிலத்துக்கு அணியென்

4. ழமொழி நானூறு- தம் நடை நோக்கார்

5.இனியவை நாற்பது- 37. இளமையை மூப்பு என்று

அலகு-4	காப்பிய இலக்கியம்

1. சிலப்பதிகாரம் – வழக்குரைகாதை
2. மணிமேகலை- பாத்திரம் பெற்ற காதை

3. பெரியபுராணம் - பூசலார் நாயனார்புராணம்
4. கம்பராமாயணம்- குகப் படலம்
5. சீறாப்புராணம் – மானுக்குப் பிணை நின்ற படலம்
6. இயேசு காவியம் -ஊதாரிப்பிள்ளை

அலகு-5	பக்தி இலக்கியமும், பகுத்தறிவு இலக்கியமும்

பக்தி இலக்கியம்;

1. திருநாவுக்கரசர் தேவாரம் - நாமார்க்கும் குடியல்லேம் எனத் தொடங்கும் பாடல் மட்டும்
2. மாணிக்கவாசகர் திருவாசகம் - நமச்சிவாய வாஅழ்க நாதன்தாள் வாழ்க முதல் சிரம்குவிவார் ஓங்குவிக்கும் சீரோன் கழல் வெல்க வரை
3. பொய்கையாழ்வார்-வையந் தகளியா வார்கடலே
4. பூதத்தாழ்வார்-அன்பே தகளியா
5. பேயாழ்வார்-திருக்கண்டேன் பொன்மேனி கண்டேன்
6. ஆண்டாள் – திருப்பாவை மார்கழித் திங்கள் (முதல் பாடல்)

பகுத்தறிவு இலக்கியம்;

- திருமூலர் – திருமந்திரம் (270,271, 274, 275 285)
- ட்டினத்தார் -திருவிடை மருதூர் (காடே திரிந்து – எனத் தொடங்கும் பாடல் ா.எண ;.279, 280)
- கடுவெளி சித்தர் - பாபஞ்செய் யாதிரு *மனமே* (பாடல் முழுவதும்)
- இராவண காவியம் – தாய்மொழிப் படலம் - 18. ஏடுகை யில்லா ரில்லை முதல் - 22. செந்தமிழ் வளர்த்தார். வரை

Text books

- .

Reference Books

- மு. வரதராசன், தமிழ் இலக்கிய வரலாறு, சாகித்ய அக்காதெமி, புதுடெல்லி.
- மது. ச. விமலானந்தன், தமிழ் இலக்கிய வரலாறு, மீனாட்சி புத்தக நிலையம், மதுரை.
- தமிழண்ணல், புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு, மீனாட்சி புத்தக நிலையம், மதுரை.
- தமிழ் இலக்கிய வரலாறு –முனைவர்.சிற்பி பாலசுப்ரமணியம், முனைவர்.சொ.சேதுபதி
- புதிய தமிழ் இலக்கிய வரலாறு– முனைவர்.சிற்பி பாலசுப்ரமணியம்,நீல.பத்மநாபன்
- தமிழ் இலக்கிய வரலாறு - டாக்டர்.அ.கா.பெருமாள்
- தமிழ் இலக்கிய வரலாறு –முனைவர். ப.ச.ஏசுதாசன்
- தமிழ் இலக்கிய வரலாறு – ஸ்ரீ குமார்
- வகைமை நோக்கில் தமிழ் இலக்கிய வரலாறு–பாக்கியமேரி

- தமிழ் பயிற்றும் முறை, பேராசிரியர் ந. சுப்புரெட்டியார் - மணிவாசகர் பதிப்பகம், சிதம்பரம்

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

Web Sources

- https://www.chennailibrary.com/
- https://www.sirukathaigal.com
- https://www.tamilvirtualuniversity.org
- https://www.noolulagam.com
- https://www.katuraitamilblogspot.com

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
CLO1	3	2	3	3	3	2	2	2	3	2	3	2
CLO2	3	3	2	2	2	3	2	3	3	2	2	2
CLO3	3	2	3	3	2	2	2	3	2	3	3	2
CLO4	1	3	3	2	2	2	3	2	3	2	3	3
CLO5	3	3	2	2	2	3	3	2	2	2	3	3

Strong -3,Medium-2,Low-1

SEMESTER - I

LANGUAGE COURSE- 1: COMMUNICATION IN FRENCH I

Course Code	BM11FL1	Course Type	Language	L	T	P	C	Syllabus version	2022-2023
				2	1	-	3		
Pre-requisite	Basic knowledge on General French								

Course Objectives:

- To equip the students with the basic language skills in French.
- To acquire practice of comprehension, communication, translation and initiation to grammar and composition writing.
- To enrich the learners' awareness of the land, people and culture of France.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Enables comprehension of the language of the native speakers.	K1, K2
CO2	• Promotes basic interaction in French with simple phrases.	K2
CO3	• Enriches the learners' knowledge of the French culture and civilization.	K2, K3
CO4	• Creates awareness of Francophone countries.	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Introducing oneself, introducing someone, and greeting each other Conjugation of fundamental verbs: être, avoir, s'appeler – Present tense Cardinal numbers and expression of date Days of the week, seasons and months of the year France and its regions Paris and its monuments Practicum: Reading aloud, introducing oneself, greeting each other.
Unit II	Identifying persons and objects Conjugation of -er verbs – Affirmation Gender – nationalities and professions Definite and indefinite articles Interrogation and negation Francophonie **Practicum:** Dictation, learning new vocabulary, researching on French culture

	and civilization.
Unit III	Asking for and giving information Describing persons and places Modes of inviting - accepting and Refusing Conjugation of –ir verbs Expressions of quantity Adjectives and prepositions Leisure of the French Familial relation Practicum: Web learning - stories, building simple sentences, learning vocabulary, writing dialogues.
Unit IV	Expressing likes, dislikes, and apologies Expressing agreement and disagreement Conjugation of –re verbs Possessive adjectives Demonstrative adjectives Imperative mood Habits - food and drinks of the French Festivals in France Practicum: Effective communication, effective writing, language lab activities, language games.
Unit V	Reading and writing an e-mail Writing letters Expression of time Colours Conjugation of irregular verbs Personal pronouns Pronominal verbs Education in France Media – television and press Internet Practicum: Making a presentation, writing well structured paragraphs, impromptu speaking, story-telling activity, discussing and debating.

(Current contours)	Campus France Alliance Française Why learn French language in India? Career scope in French Higher studies in France Learning French with smartphone apps

Recommended References:

1. Cocton Marie-Noëlle et al, *Saison 1*, Les Éditions Didier, Paris, 2015.
2. Mérieux Régine, Loiseau Yves, *Latitudes 1*, Les Éditions Didier, Paris, 2008.
3. Cocton Marie-Noëlle et al, *Génération1*, Les Éditions Didier, Paris, 2010.
4. Poisson-Quinton et al, *Festival 1*, CLE International, Paris, 2005.
5. Girardet, Jacky, Pécheur J, *Écho 1*, CLE International, Paris, 2013.
6. Berthet, Hugot et al, *Alter Ego 1*, Hachette, Paris, 2012.
7. Mérieux Régine, Loiseau Yves, *Connexions 1*, Les Éditions Didier, Paris, 2011.
8. Girardet Jacky, Cridlig Jean-Marie, *Panorama 1*, CLE International, Paris, 2004.
9. Claire Miquel, *Communication Progressive du Français*, CLE International, Paris, 2004.
10. Girardet Jacky, Pécheur Jacques, *Campus 1*, CLE International, Paris, 2002.
11. Madanagobalane et al, *Synchronie 1*, Samhita Publications, Chennai, 2011.
12. Dominique, Philippe et al, *Le Nouveau Sans Frontières 1*, CLE International, Paris, 2011.
13. Capelle, Guy, Menand, Robert, *Le nouveau taxi A1*, Hachette, Paris, 2009.

Related Online Contents:

1. https://alison.com/course/basic-french-language-for-everyday-life
2. https://www.youtube.com/watch?v=4SKzf9wlqpA
3. https://www.languagehelpers.com/words/french/basic.html
4. http://www.omniglot.com/language/kinship/french.ht
5. https://www.fluentu.com/blog/french/best-apps-for-learning-french/

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SEMESTER - I

LANGUAGE COURSE -1: ENGLISH FOR EFFECTIVE COMMUNICATION I

Course Code	BM11EL1	Course Type	LANGUAGE	L	T	P	C	Syllabus version	2022-2023
				2	1	-	3		
Pre-requisite	Basic knowledge on General English								

Course Objectives:

- To expose learners to various styles of prose writing and different ways of narrations
- To equip learners with the basics of English grammar
- To help learners develop their writing skills

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Becoming accomplished and active learners	K2
CO2	• Transforming and narrating real life stories in English.	K1, K2
CO3	• Communicating with appropriate grammatical forms	K2
CO4	• Ability to write sentence grammatically	K3
CO5	• Usage of various sentence structures	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Module 1 (Prose) Martin Luther King - "I Have a Dream" R.L. Stevenson - "Walking Tours" Philip Larkin's - "The Pleasure Principle" Practicum: Exercises in summarizing and essay writing.
Unit II	Module 2 (Short Story) R. K. Narayan - "A Snake in the Grass" Ruskin Bond - "The Cherry Tree" Oscar Wilde - "A Model Millionaire" Leo Tolstoy - "Where Love is, God is" Practicum: Creative thinking and writing, narrating stories.

Unit III	Parts of Speech Forms of 'Be': Negative and Positive; Question tags Tense – Past, Present and Future – Perfect, Continuous, Perfect Continuous – Verbs: Transitive and Intransitive; Active and Passive, Modals and Phrasal verbs Practicum: Identifying and analyzing the grammar of grammatical words.
Unit IV	Sentences and Clauses: Adverbial and Conditional Clauses; Reported Speech Using Conjunction and Connectives, Writing letters, Paragraphs and Essays Practicum: Identifying and framing phrases, clauses and sentences.
Current Contours	**(For Continuous Internal Assessment only)** Communication in the digital era –writing for the New Media-language of Social Media.

Recommended References:

1. Text Book: Krishnaswamy, N. Modern English: A Book of Grammar Usage and Composition. Macmillan India Ltd, 2009. Print. (Module III & IV)
2. Honey Dew: An Anthology of Prose, Poetry and One-act Plays. 2014 ed. Hyderabad: Orient Black Swan, 2014. Print.
3. "How I Became a Public Speaker." The Best Words. Hyderabad: Orient Black Swan, 2015. 94-101. Print.
4. Joshi, L.M, ed. Masters of English Prose: From Bacon to Beerbohm. New Delhi: Orient Black Swan, 2014. Print.

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SEMESTER - I

CORE COURSE -1: CELL BIOLOGY

Course Code	BM11C1	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on cell biology								

Course Objectives:

- To explain the concept of Chemical Basis of Life
- To describe the structural organization of cell and its organelles
- To enlighten the functional role of the cellular organelles.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend the basis of life.	K1, K2
CO2	• Describe various features differentiating eukaryotes from prokaryotes.	K1, K2
CO3	• Illustrate the morphological and structural organization of cell organelles.	K3
CO4	• Describe functional characteristics of cell organelles.	K7
CO5	• Understand the dynamics of cell division in somatic and germ cells.	K1, K2, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	The Chemical Basis of Life; Cells as the basic unit of life - Unicellular and Multicellular Organisms; Plant cell and Animal cells. Different shapes and types of cells. General structural organization of prokaryotic & Eukaryotic cells. Extra cellular matrix and cell junctions. Differences between Prokaryotes and Eukaryotes;
Unit II	Cytoplasm: Physical, chemical and biological properties. The cytoskeleton – Microtubules, Microfilaments and intermediate filaments, MTOC - Centrosomes – Morphology, ultra-structure and functions.
Unit III	Endomembrane system - Plasma membrane: Structure, modifications, permeability and other functions – ER, Golgi complex – Morphology, ultra structure and functions. Lysosomes and Peroxisomes-Morphology, ultra structure and functions.
Unit IV	Cell organelles – Mitochondria– Morphology, ultra structure and functions. Ribosomes – Ultra-structure, subunits – Role in protein synthesis. Chloroplasts – Basic overview.

Unit V	Nucleus – Ultra-structure and organization - Chromosomes: Morphology, structure, chemistry – Types: Giant chromosomes – polytene and lamp-brush chromosomes – Cell division – Mitosis, meiosis, cell cycle and dynamics of cell division.
Current Contours	**(Not for Final Exam, only for Discussion)** Know about various patterns and stages of cleavage in animal cells (e.g. Frog's egg)

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	S	VS	S
CO3	VS	VS	VS	VS	VS
CO4	VS	VS	VS	M	VS
CO5	VS	VS	M	S	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. De Robertis. (2020). Cell and Molecular Biology 8th edition.
2. C.B. Powar. (2019). Cell Biology 3rd edition.
3. Sheeler P & Bianchi De (2009). Cell & Molecular Biology 3rd edition.
4. Wolfe S L. (1981). Biology of the Cell 2nd edition.
5. Bruce & Albert. (2022). Biology of the Cell 7th edition.
6. Geoffrey M. Cooper. (2004). The Cell 3rd edition.

Related Online Contents:

1. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/41

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SEMESTER – I

LABORATORY COURSE -1: CELL BIOLOGY

Course Code	BM11CP1	Course Type	Laboratory Course	L	T	P	C	Syllabus version	2022-2023
				1	-	3	3		
Pre-requisite	Basic knowledge on cell biology								

Course Objectives:

- To view different types and shapes of cells in human.
- To study the functional role of plasma membrane.
- To study and observe different stages of mitotic cell division

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the working principles and operations of basic laboratory instruments.	K1, K2, K3
CO2	• Perform staining techniques to observe various cells.	K3, K4, K7
CO3	• Identify different stages of somatic cell division.	K3, K7
CO4	• Assess different cleavage patterns of frog embryos and observe different types of cells.	K4
CO5	• Identify different cellular organelles.	K1, K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Basics of Instruments- Parts and the working principle of the compound Microscope. Parts and the working principle of the Centrifuge
Unit II	Experiments to observe prokaryotic and eukaryotic cells 1. Blood smear preparation and leishmann staining to observe different types of cells of blood tissue; 2. Observation of Prokaryotic cell by methylene blue staining; 3. Demonstration of Gram staining method of staining to differentiate the cell wall nature of bacteria and observing gram positive and gram negative bacteria.
Unit III	Experiments to study the functional property of plasma membrane - Membrane Permeability of RBC. Experiments to observe the different stages of mitosis - Study of mitosis in onion root tip cells.
Unit IV	Cleavage pattern in animal cells- Observation of slides showing cleavage pattern in frog embryos -1. Frog two cell stage 2. Frog 4 cell stage 3. Frog Blastula. To observe different types of cells.

Unit V	Identification of Cell organelles – study of structural and functional role of Cell organelles using models 1. Mitochondria 2. Golgi complex 3. Ribosomes 4. Fluid Mosaic Model – Plasma membrane 5. Microsomes.
Current Contours	**(Not for Final Exam, only for Discussion)** Demo video to show the polytene chromosomes from salivary glands of Chironomous larva. Demo video to show grasshopper testis squash preparations to view different stages of meiosis.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	VS	VS	VS
CO3	VS	M	S	VS	VS
CO4	S	VS	VS	VS	M
CO5	S	VS	VS	S	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Dr. Renu Gupta (Author), Dr. Seema Makhija (Author), Dr. Ravi Toteja. (2018). Cell Biology: Practical Manual.
2. Amit Gupta (Author), Bipin Kumar Sati (Author). (2019). Practical laboratory manual CELL BIOLOGY.
3. M.M. Trigunayat & Kritika Trigunayat. (2019). A Manual of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology Part 1.

Related Online Contents:

1. https://www.youtube.com/watch?v=5-ur7bWqlDQ
2. https://www.youtube.com/watch?v=mh7i3nhzXzk

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SEMESTER - I

ALLIED COURSE -1: MATHEMATICS

Course Code	BM11AC1	Course Type	Allied	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on Mathematics								

Course Objectives:

- To solve the system of the algebraic equations and compute Eigen values and Eigen vectors of a given matrix.
- To know how to solve the first order and higher order ordinary differential equations.
- To study the basic concepts and definitions of partial differential equations.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Be able to carry out matrix operations, including inverses and determinants.	K2
CO2	• Apply partial differential equations to science and Biomedical engineering problems.	K1, K2
CO3	• Use a statistical package, both for numerical work and to help to the data required for Biomedical engineering analyze	K3
CO4	• Find the sample regression line.	K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Matrix: Algebra of Matrix - Inverse of non-singular Matrix and its properties - Rank of Matrix and its determination using elementary row and column operation - Solution of system of linear equation- Eigen values and Eigen vector.
Unit II	Ordinary differential equation: Knowledge of limit and continuity, derivatives-First order linear differential equation — methods of solving — Higher order differential equation with constant coefficient - methods of solving.

Unit III	Calculus of function of several variable: Homogeneous function and Euler theorem — Chain rules — Differentiation on Implicit functions - Total differentiation - Jacobian upto three variables - Maxima and Minima.
Unit IV	Numerical Methods: Solutions of nonlinear algebraic equations- Iterative methods for solving differential equations - Numerical integration.
Unit V	Statistics: Sampling theory -Mean- Median - Mode - Variance and Standard Deviation- Correlation and Regression analysis -Testing of Hypothesis.

Recommended References:

1. Ajit Kumar and S. Kumaresan, A Basic Course in Real Analysis, CRC Press, Third Indian Reprint, 2015.
2. Edward D. Gaughan, Introduction to Analysis, AMS, Indian edition, 2010.
3. E.A. Coddington, Ordinary Differential Equaitons, McGraw Hill, 1989.
4. M.E. Taylor, Introduction to Differential Equations, AMS Indian Edition, 2011.
5. Gallian, Contemporary Abstract Algebra, Cenpage Learning India Pvt Ltd., Ninth Edition, 2019.
6. Mark R. Sepanski, Algebra, AMS Indian Edition, 2012.
7. David S. Dummit and Richard M. Foote, Abstract Algebra, Wiley, Third Edition, 2011.
8. Serge Lang. Algebra - Revised third edition - Springer - Verlag - 2005.
9. Ian Stewart, Galois Theory, Chapman and Hall/CRC,Fourth edition 2015.

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SEMESTER - I

COURSE: VALUE EDUCATION – MEN AND SOCIETY

Course Code	BM11VE	Course Type	VALUE EDUCATION	L	T	P	C	Syllabus version	2022-2023
				1	1	-	2		
Pre-requisite	Basic knowledge on Society								

Course Objectives:

- To understand the philosophy of life and values through Thirukural
- Toanalysethecomponentsofvalueseducationtoattainthesenseofcitizenship
- To understand different types of values towards National Integration and international understanding

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Apply the values in Thirukural to be peaceful, dutiful and responsible in family and society	K1, K3
CO2	• Develop character formation and sense of citizenship	K2
CO3	• Be secular, self-control, sincere, respectful and moral.	K1, K2
CO4	• Master yoga, asana and meditation to promote mental health	K4
CO5	• Be attitudinal to follow the constitutional rights	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	PHILOSOPHY OF LIFE AND SOCIAL VALUES: Human Life on Earth (Kural 629) - Purpose of Life (Kural 46) - Meaning and Philosophy of Life (Kural 131, 226) -Family (Kural 45), Peace in Family (Kural 1025) Society (Kural 446), The Law of Life (Kural 952), Brotherhood (Kural807) Five responsibilities/duties of Man (a) to himself (b) to his family (c) to his environment (d) to his society, (e) to the Universe in his lives (Kural 43,981).
Unit II	HUMANVALUESANDCITIZENSHIP Aim of education and value education: Evolution of value oriented education, Concept of Human values: types of Values- Character Formation – Components of Value education- AP J Kalam's ten points for enlightened citizenship-The role of media in value building
Unit III	VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT: Constitutional or national values: Democracy, socialism, secularism, equality, Justice, liberty, freedom and fraternity - Social Values: Pity and probity, self-control, universal brotherhood - Professional Values - Knowledge thirst, sincerity

	in profession, regularity, punctuality and faith -Religious Values: Tolerance, wisdom, character – Aesthetic Values- Love and appreciation of literature and fine arts and respect for the same- National Integration and International Understanding.
Unit IV	YOGAANDHEALTH: Definition, Meaning, Scope of Yoga - Aims and objectives of Yoga – Yoga Education with modern context - Different traditions and schools of Yoga - Yoga practices: Asanas, Pranayama and Meditation.
Unit V	HUMANRIGHTS: Concept of Human Rights: Indian and international perspectives- Evolution of Human Rights- definitions under Indian and International documents–Broad classification of Human Rights and Relevant Constitutional Provisions: Rightto Life, liberty ad Dignity- Right to equality- Right against exploitation- Cultural and Educational Right- Economic Rights- Political Rights- Social Rights - Human Rights of Women and Children – Peace and harmony.

Recommended References:

1. Thirukkural with English Translation of Rev. Dr. G. U. Pope, Uma Publication,156, Serfoji Nagar, Medical College Road, Thanjavur 613 004
2. V.R. KrishnaIyer, Dialetics and Dynamics of Human Rights in India, Tagore Law Lectures.
3. Yogic Thearpy -Swami Kuvalayananda and Dr. S.L. Vinekar, Government of India, Ministry of Health, New Delhi.
4. SOUNDHEALTH THROUGHYOGA-Dr. K. Chandrasekaran, Prem Kalyan Publications, Sedaptti, 1999.
5. Grose. D. N – “A text book of Value Education ’New Delhi (2005)
6. Gawande. EN – “Value Oriented Education” – Vision for better living. New Delhi (2002) Saruptsons
7. Brain Trust Aliyar- “Value Education for Health, Happiness and Harmony” Erode (2004) Vethathiri publications

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பொதுத்தமிழ் - 2

தமிழ் இலக்கிய வரலாறு -2

முதலாம் ஆண்டு – இரண்டாம் பருவம்

Course Code	Course Name	category	L	T	P	S	Credits	Ins.Hrs	CIA	External	Total
BM12TL2A	பொதுத்தமிழ் -2 தமிழ் இலக்கிய வரலாறு -2	Supportive	Y	-	-	-	3	6	25	75	100
Pre-Requisite		பன்னிரெண்டாம் வகுப்பில் தமிழை ஒரு பாடமாகப் பயின்றிருக்க வேண்டும்							SV 2023		

Learning Objectives

- முதலாமாண்டுப் பட்ட வகுப்பு மாணவர்களுக்குத் தமிழ் மொழி இலக்கியங்களை அறிமுகம் செய்தல்
- தமிழ் இலக்கியப் போக்குகளையும், இலக்கணங்களையும் மாணவர் அறியுமாறு செய்து அவர்களின் படைப்பாற்றலைத் தூண்டுதல்
- தமிழ் இலக்கியம் சார்ந்த போட்டித் தேர்வுகளுக்கு ஏற்ப கற்பித்தல் நடைமுறைகளை மேற்கொள்ளுதல்

Expected Course Outcomes

On the Sucessful completion of the Course, Students will be able to

இப்பாடத்தைக் கற்பதால் பின்வரும் பயன்களை மாணவர் அடைவர்

CO 1	சிற்றிலக்கியங்களின்வழி இலக்கியச் சுவையினையும் பண்பாட்டு அறிவினையும் பெறுவர்	K4
CO 2	புதுக்கவிதை வரலாற்றினை அறிந்து கொள்வர்	K5, K6
CO 3	திராவிட இயக்க இலக்கியங்களைக் கற்பதன் மூலம் மொழி உணர்வு , இன உணர்வு, சமத்துவம் சார்ந்த சிந்தனைகளைப் பெறுவர்	K3
CO 4	தமிழ்மொழியைப் பிழையின்றி எழுதவும், புதிய கலைச்சொற்களை உருவாக்கவும் அறிந்து கொள்வர்	K3
CO 5	போட்டித் தேர்வுகளில் வெற்றி பெறுவதற்குத் தமிழ்ப் பாடத்தினைப் பயன்கொள்ளும் வகையில் பயிற்சி பெறுவர்.	K2

K1 - Remember; K2 - Undestand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

அலகு-1	தமிழ் இலக்கிய வரலாறு அறிமுகம்.

1. சிற்றிலக்கியம்; குறவஞ்சி, கலம்பகம், உலா, பரணி, பள்ளு, பிள்ளைத்தமிழ், தூது, அந்தாதி.
2. தனிப்பாடல் அறிமுகம்
3. இக்கால இலக்கியம் ;கவிதை, சிறுகதை,நாடகம், உரைநடை. , திராவிட இயக்கம் வளர்த்த தமிழ்.

அலகு-2	சிற்றிலக்கியக்கமும்,தனிப்பாடலும்

சிற்றிலக்கியம்;

- கலிங்கத்து பரணி- விருந்தினரும் வறியவரு நெருங்கி யுண்ணரும் - முதல் - கேட்பாரைக் காண்மின் காண்மின் - வரை
- திருக்குற்றாலக் குறவஞ்சி - வானரங்கள் கனிகொடுத்து
- முக்கூடற் பள்ளு - ஆற்று வெள்ளம் நாளை வரத்
- அபிராமி அந்தாதி- கலையாத கல்வியும் குறையாத வயதும் (பதினாறு செல்வங்கள்)
- திருவரங்கக் கலம்பகம் – மறம் -பிள்ளைப் பெருமாள் ஐயங்கார்-பேசவந்த தூத செல்லரித்த ஓலை செல்லுமோ
- தமிழ்விடு தூது முதல் பத்து கண்ணிகள்

தனிப்பாடல்;

- வான்குருவி யின்கூடு -ஔவையார்
- ஆமணக்குக்கும் யானைக்கும் சிலேடை ;முத்திருக்கும் கொம்பசைக்கும் மூரித்தண் டே - காளமேகப் புலவர்
- இம்பர் வான் எல்லை இராமனையே பாடி -வீரராகவர்
- நாராய் நாராய் -சத்தி முத்தப் புலவர்

அலகு-3	இக்கால இலக்கியம்- 1

1. ாரதியார் பாரத சமுதாயம் வாழ்கவே
2. ாரதிதாசன் - சிறுத்தையே வெளியில் வா
3. நாமக்கல் கவிஞர்-கத்தியின்றி
4. தமிழ் ஒளி – மீன்கள் (அந்தி நிலா பார்க்க வா)
5. ஈரோடு தமிழன்பன் – எட்டாவது சீர் (வணக்கம் வள்ளுவ)

சிறுகதைகள்;_

1. புதுமைப்பித்தன் - கடிதம்
2. ஜெயகாந்தன் -வாய்ச் சொற்கள் (மாலை மயக்கம் தொகுப்பு)
3. ஆர். சூடாமணி - அந்நியர்கள்

உரைநடை ;

1. மு வ கடிதங்கள் - தம்பிக்கு நூலில் முதல் இரண்டு கடிதங்கள்

அலகு-4	இக்கால இலக்கியம்- 2

1. தந்தை பெரியார் – திருக்குறள்(மாநாட்டு) உரை
2. பேரறிஞர் அண்ணா – இரண்டாம் உலகத் தமிழ் மாநாட்டு உரை
3. கலைஞர் மு. கருணாநிதி – தொல்காப்பிய பூங்கா –எழுத்து -முதல் நூற்பா கட்டுரை

நாடகம் / திரைத்தமிழ் :

1. வேலைக்காரி –திரைப்படம்

2. ராஜா ராணி -சாக்ரடீஸ் -ஓரங்க நாடகம்

இதழியல் தமிழ் ;

முரசொலி கடிதம்

1. செம்மொழி வரலாற்றில் சில செப்பேடுகள்

அலகு-5	மொழிப் பயிற்சி

<u>சொல் வேறுபாடு / பிழை தவிர்த்தல்</u>

- வாசிப்பது – வாசிப்பவர்
- சுவர்- சுவரில்
- வயிறு - வயிற்றில்
- கோயில்- கோவில்
- கறுப்பு – கருப்பு
- இயக்குநர்-இயக்குனர்
- சில்லறை-சில்லரை
- முறித்தல் – முரித்தல்
- மனம்-மனசு- மனது
- அருகில்-அருகாமையில்
- அக்கரை- அக்கறை
- மங்கலம்- மங்களம்.

பயிற்சி :

- ிழையான சொற்களை ஒரு பத்தியில் கொடுத்து அந்தப் பிழையான சொற்களைச் சரியாக எழுதச் செய்தல்
- சிறிய பத்தி ஒன்றை ஆங்கிலத்தில் கொடுத்து அதனைத் தமிழில் மொழிபெயர்க்க வைத்தல்.

Text books

- .

Reference Books

- மு. வரதராசன், தமிழ் இலக்கிய வரலாறு, சாகித்ய அக்காதெமி, புதுடெல்லி.
- மது. ச. விமலானந்தன், தமிழ் இலக்கிய வரலாறு, மீனாட்சி புத்தக நிலையம், மதுரை.
- தமிழண்ணல், புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு, மீனாட்சி புத்தக நிலையம், மதுரை.
- தமிழ் இலக்கிய வரலாறு –முனைவர்.சிற்பி பாலசுப்ரமணியம், முனைவர்.சொ.சேதுபதி
- புதிய தமிழ் இலக்கிய வரலாறு– முனைவர்.சிற்பி பாலசுப்ரமணியம்,நீல.பத்மநாபன்
- தமிழ் இலக்கிய வரலாறு - டாக்டர்.அ.கா.பெருமாள்
- தமிழ் இலக்கிய வரலாறு –முனைவர். ப.ச.ஏசுதாசன்
- தமிழ் இலக்கிய வரலாறு - ஸ்ரீ குமார்

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- தமிழ் பயிற்றும் முறை, பேராசிரியர் ந. சுப்புரெட்டியார் - மணிவாசகர் பதிப்பகம், சிதம்பரம்

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

Web Sources

- https://www.chennailibrary.com/
- https://www.sirukathaigal.com
- https://www.tamilvirtualuniversity.org
- https://www.noolulagam.com
- https://www.katuraitamilblogspot.com

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
CLO1	3	2	3	3	3	2	2	2	3	2	3	2
CLO2	3	3	2	2	2	3	2	3	3	2	2	2
CLO3	3	2	3	3	2	2	2	3	2	3	3	2
CLO4	2	3	3	2	2	2	3	2	3	2	3	3
CLO5	3	3	2	2	2	3	3	2	2	2	3	3

Strong -3,Medium-2,Low-1

SEMESTER - II

LANGUAGE COURSE- 2: COMMUNICATION IN FRENCH II

Course Code	BM12FL2	Course Type	Language	L	T	P	C	Syllabus version	2022-2023
				2	1	-	3		
Pre-requisite	Basic knowledge on General French								

Course Objectives:

- To expand learners' acquisition of language skills in French
- To demonstrate competence in reading, writing, listening and speaking French.
- To enrich learners 'awareness of the land, people and culture of France.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Enhances the learner's reading and translating skills.	K1, K2
CO2	• Promotes interpersonal communicative skills.	K2
CO3	• Creates awareness of Francophone countries.	K2, K3
CO4	• Enriches the learners' knowledge of the French culture and civilization.	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Giving one's opinion Complaining and felicitating Present continuous tense Future tense Negative forms – ne … plus, ne… rien, ne … personne, ne …jamais Recent past Future proche French lifestyle – metro, boulot, dodo Meals of the French Practicum: Reading aloud, communication in class, conjugation of verbs.
Unit II	Seeking and giving information Ordering, warning Past tense

	Past continuous Conditional present Reading habits of the French Journals of France Practicum: Dictation, learning new vocabulary, researching on French culture and civilization.
Unit III	Narrating and reporting Seeking and giving permission, forbidding Expression of duration Demonstrative pronouns Direct object pronouns Indirect object pronouns Pronouns en and y Transport in France Climate of France Practicum: Web learning - stories, dialogue Reading, constructing/ translating sentences, learning vocabulary.
Unit IV	Advising Discussing and debating Accepting and refusing Partitive articles Pronominal verbs Dressing style of the French Politics of France Practicum: Effective communication, effective writing, language lab activities, language games.
Unit V	Inviting for food Reporting speech Adverbs Relative pronouns Television in France Emergency - Police / Fire / SAMU La colocation Practicum: Making a presentation, writing well structured paragraphs, impromptu speaking, story-telling activity, discussing and debating.

(Current contours)	Internships in France Learn French with songs A little history of France Indo-French Relation French culture in India

Recommended References:

1. Cocton Marie-Noëlle et al, Saison 1, Les Éditions Didier, Paris, 2015.
2. Mérieux Régine, Loiseau Yves, Latitudes 1, Les Éditions Didier, Paris, 2008.
3. Cocton Marie-Noëlle et al, Génération1, Les Éditions Didier, Paris, 2010.
4. Poisson-Quinton et al, Festival 1, CLE International, Paris, 2005.
5. Girardet, Jacky, Pécheur J, Écho 1, CLE International, Paris, 2013.
6. Berthet, Hugot et al, Alter Ego 1, Hachette, Paris, 2012.
7. Mérieux Régine, Loiseau Yves, Connexions 1, Les Éditions Didier, Paris, 2011.
8. Girardet Jacky, Cridlig Jean-Marie, Panorama 1, CLE International, Paris, 2004.
9. Claire Miquel, Communication Progressive du Français, CLE International, Paris, 2004.
10. Girardet Jacky, Pécheur Jacques, Campus 1, CLE International, Paris, 2002.
11. Madanagobalane et al, Synchronie 1, Samhita Publications, Chennai, 2011.
12. Dominique, Philippe et al, Le Nouveau Sans Frontières 1, CLE International, Paris, 2011
13. Capelle, Guy, Menand, Robert, Le nouveau taxi A1, Hachette, Paris, 2009.

Related Online Contents:

1. http://french.languagedaily.com/wordsandphrases/useful-french-phrases
2. https://www.fluentu.com/blog/french/advanced-french-words/
3. http://simple-french.com/category/french-lessons/french-vocabulary/advanced-vocabulary/
4. http://french.languagedaily.com/wordsandphrases/most-common-words
5. https://www.lawlessfrench.com/faq/lessons-by-level/b1-vocabulary/
6. http://frenchlessonsaustralia.com.au/frenchvocabulary/#Construction_construction
7. https://www.talkinfrench.com/50-common-french-phrases/

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SEMESTER - II

LANGUAGE COURSE -2: ENGLISH FOR EFFECTIVE COMMUNICATION II

Course Code	BM12EL2	Course Type	LANGUAGE	L	T	P	C	Syllabus version	2022-2023
				2	1	-	3		
Pre-requisite	Basic knowledge on General English								

Course Objectives:

- To enable learners to understand different styles of prose writing and narratives
- To equip learners with grammar towards proficiency development
- To make learners develop their analytical reading skills

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Becoming accomplished and active.	K1
CO2	• Transforming and narrating real life stories in English.	K2
CO3	• Demonstration on framing questions.	K2, K3
CO4	• Ability to write sentences grammatically.	K3
CO5	• Usage of various sentence structures.	K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Module 1 Prose: Swami Vivekananda - “To Madras Disciples” George Orwell - “Politics and the English Language” G.K. Chesterton - “On Running after One’s Hat” Practicum: Exercises in summarizing and essay writing.
Unit II	Module 2 Short Story: K A Abbas - “The Sparrow” O’ Henry - “The Ransom of Red Chief” Rabindranath Tagore - “Kabuliwala” Practicum: Creative thinking and writing, narrating stories.

Unit III	Module 3: Articles and Determiners, Pronouns and its various types, Prepositions, Adjectives and Adverbs, Word Order, Conjunction and Clauses Practicum: Identifying and analyzing the grammar of grammatical words.
Unit IV	Module 4: Tense - Present, Past, Present Perfect Question tags using Modals and "wh" words Passive, Verb forms, Future, Modals, Imperatives, There and It, Auxiliary Verbs, Questions, Reported Speech Practicum: Practice in usage of various tenses.
Current Contours	**(For Continuous Internal Assessment only)** English for 21st century Professions-recent development in the job market-discourse for the New Media and Social Media-Language demands of the 21st century.

Recommended References:

1. Text Book: Murphy, Raymond. Essential English Grammar: A Self-Study Reference and Practice Book for South Asian Students of English with Answers. Cambridge: Cambridge UP, 2002. Print. (Module III & IV)
2. Honey Dew: An Anthology of Prose, Poetry and One-act Plays. 2014 ed. Hyderabad: Orient BlackSwan, 2014. Print.
3. Joshi, L.M, ed. Masters of English Prose: From Bacon to Beerbohm. New Delhi: Orient BlackSwan, 2014. Print.
4. "Marriage is a Private Affiar. " Exploring English. 3rd ed. Hyderabad: Orient BlackSwan, 2011. 59-68. Print.
5. The Best Words. Hyderabad: Orient BlackSwan, 2015. 94-101. Print.

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SEMESTER - II

CORE COURSE -2: HUMAN ANATOMY AND PHYSIOLOGY

Course Code	BM12C2	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on general biology								

Course Objectives:

- To provide knowledge on general anatomy of human body, including the basic anatomy and medical terminology
- To understand the function of major organ systems and its physiological relationship with each other.
- To introduce the recent trends in Human Anatomy & physiology

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Define descriptive terms in Anatomy &Physiology	K1, K2
CO2	• Differentiate the levels of organization in the human body and the characteristics of each.	K2
CO3	• Identify various organs of different systems of human body	K1, K3
CO4	• Explain the major body cavities and its associated organ system	K2
CO5	• Describe the functions of organ systems of the body	K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Commonly used descriptive terms in Anatomy – Body plans-A brief introduction to bones, joints and muscles of the body – A brief introduction to organ systems of the body – Skeletal system: Bones of the upper limb, Bones of the lower limb, the vertebral column, the sternum, ribs and joints, the skull- Integumentary system: Skin and its derivatives, functions of skin.

Unit II	Nervous system: Structure of nerve cell, Brain, spinal cord and peripheral nerves, General function of neuronal cells - Motor system – Autonomic nervous system and its control. Special sensory organs system: Visual, Auditory, Vestibular, Chemical sensory system-Muscular system: Structure and type of muscles in human body-Molecular mechanism of muscle contraction- Neuromuscular transmission and excitation.
Unit III	Circulatory system: Structure of heart and blood vessels, systematic circulation, pulmonary circulation, portal circulation, and coronary circulation- Composition of blood and its function- red blood cells and Hemoglobin-Blood Groups-Transfusion- Leukocytes, granulocytes, Monocyte, Lymphocytes- Hemostasis and blood coagulation-Microcirculation-Lymphatic system: Lymph vessels, lymphoid organs, lymph circulation and functions of lymphatic system.
Unit IV	Digestive system: Gastrointestinal tract and associated glands - Secretary functions of alimentary tract: Secretion of saliva, Mechanism of salivary glands regulation, Gastric secretion (Hcl, Pepsin, Mucus, Bicarbonates and Intrinsic factor), Pancreatic secretion, Secretion of bile, small and large intestine- Motility of the gastro intestinal tract - Gastro intestinal hormones-Digestion and absorption- Respiratory system: Trachea, lungs including other air passages, Mechanism of pulmonary and alveolar ventilation-Overall process of gas exchange in the lungs and tissues- Hypoxia, Pulmonary Edema, Asthma and COPD.
Unit V	Renal system: Structure of Kidney, Urinary bladder and urethra- Acid, Base Balance –mechanism of urine formation (glomerular filtration and tubular reabsorption)-Reproductive system: Structure of female reproductive gonads and tract. Structure of male reproductive and accessory organs, spermatogenesis, physiology of menstruation, fertilization & oogenesis - Endocrine system: General mechanism of hormone action – Hyphothalamus and Pituitary gland, Thyroid gland Parathyroid gland, pineal gland, Adrenal gland & thymus.
Current Contours	**(Not for Final Exam, only for Discussion)** Artificial organ, Robotic Internal organs, Developments in 3D bio printing for tissue and organ Regeneration-Bionic Physiology-Milestones discoveries in human Anatomy and Physiology.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	M	VS	VS
CO2	VS	S	M	VS	VS
CO3	VS	VS	VS	S	VS
CO4	VS	VS	VS	S	M
CO5	VS	S	S	S	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Inderbir Singh. (2005). Anatomy and Physiology for Nurses, Jaypee Brothers Medical Publishers (P) Ltd.
2. Inderbir Singh. (2016). Human Anatomy, Jaypee Brothers Medical Publishers (P) Ltd.
3. Gray, Henry, Philadelphia: Lea & Febiger (1918). Anatomy of the Human Body.
4. Hall. J.E. Guyton and Hall. (2011). Textbook of Medical Physiology. 12th ed. Saunders, Elsevier Inc.,
5. Robert M. Berne and Matthew N. Levy (1990) Principles of Human Physiology (Third Edition) Mosby Publications.
6. Cary A. Thibodeau and Kevin T. Patton Anthony's (2012) Text Book of Anatomy & Physiology (7th Edition), Mosby Publications.
7. Priya Ranganath and Leelavathy N. (2018). Basics in Human Anatomy for B.Sc., Paramedical Courses, *Jaypee Publications*, 2nd Edition ISBN: 978-93-5270-493-4.
8. Stephen Coombes, Reuben O'Dea, Rachel Nicks. (2024). Brain anatomy and dynamics: A commentary on "Does the brain behave like a (complex) network? I. Dynamics" by Papo and Buldú Physics of Life Reviews, Volume 49, Pages: 38-39, ISSN 1571-0645, https://doi.org/10.1016/j.plrev.2024.03.004.

Related Online Contents:

1. http://www.bartleby.com/107/
2. http://academic.pgcc.edu/~aimholtz/AandP/Practicals.html
3. https://www.getbodysmart.com/a-p-resources
4. http://facstaff.cbu.edu/aross/APII/AP218home.htm
5. Katrin Amunts, Daniel Zachlod, Human brain anatomy and atlases, Reference Module in Neuroscience and Biobehavioral Psychology, Elsevier, 2024, ISBN 9780128093245, https://doi.org/10.1016/B978-0-12-820480-1.00187-X

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SEMESTER – II

LABORATORY COURSE -2: HUMAN ANATOMY AND PHYSIOLOGY

Course Code	BM12CP2	Course Type	Laboratory Course	L	T	P	C	Syllabus version	2022-2023
				1	-	3	3		
Pre-requisite	Basic knowledge on human biology and laboratory skill								

Course Objectives:

• To substantiate and clarify the theoretical concepts of each human anatomy through models Identification, demonstration and spotter's identification.
• To perform physiological analysis blood and other body fluids.
• To observe and identify varies spotter's pertaining to physiology.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Identify and locate anatomical terms of human body parts.	K2
CO2	• Understand the components of various organ systems.	K2, K3
CO3	• Examine blood group and Rh factor determination.	K4
CO4	• Analyse pulse rate and blood pressure measurement.	K1, K4
CO5	• Demonstrate registration & Measure BMI calculation	K7
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Experiments

1. Human Anatomy Models Identification and Demonstration
   i. Skeletal system
   ii. Digestive system
   iii. Reproductive system
   iv. Nervous system (Brain)
   v. Sensory system (Eye & Ear)
   vi. Circulatory system (Heart)
   vii. Renal system
   viii. Respiratory system
2. Blood Smear Preparation and Staining
3. Estimation of haemoglobin (Sahl's method).
4. Total RBC count
5. Total WBC count (TLC)
6. Differential leukocyte count (DLC)
7. Determination of bleeding time & clotting time
8. Determination of blood group and Rh factor

9. Recording of body temperature, pulse rate, BMI Calculation and blood pressure

10. Study of pregnancy diagnosis test & Contraceptive devices.

Spotters:

1) Recording ECG and its interpretation.
2) Pacemaker
3) Dialyzer
4) Sphygmomanometer

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	S	VS	VS	VS
CO2	VS	S	VS	VS	VS
CO3	VS	VS	VS	VS	VS
CO4	VS	VS	M	VS	M
CO5	S	VS	S	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. S.R. Kale &R. R. Kale. (2018). Practical Human Anatomy and Physiology, Nirali Prakashan Publications.
2. S.K. Pandey, Varun Dutt Sharma. (2014). Human Anatomy and Physiology: Practical Notebook for 1stYear Diploma in Pharmacy, CBS Publishers & Distributors Pvt. Ltd.
3. G. K. Pal& P. Pal. (2006). Textbook of Practical Physiology. 2nd Edn. Orient Black swan.

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SEMESTER - II

ALLIED COURSE - 2: CHEMISTRY

Course Code	BM12AC2	Course Type	Allied	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on Chemistry								

Course Objectives:

- To study the properties, and applications of heterocyclic compounds
- To classify the principles of stereoisomerism
- To examine the mechanisms of metal-based drugs

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Summarize the structure, properties, and behavior of molecules	K1, K2
CO2	• Understand the concept of conformational analysis	K2, K6
CO3	• Summarize the role of bio-coordination compounds	K2, K5
CO4	• Explain the concepts and principles of chemical kinetics	K2, K3
CO5	• Examine the importance of pH and buffer solutions	K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	**Bonding concepts:** Ionic, covalent, coordinate, metallic, hydrogen bonds and non- covalent bonds. Hybridization and geometry of molecules: methane, ethylene, acetylene, and benzene. Homolytic and heterocyclic fission of bonds – reactive intermediates – carbocations and free radicals **Heterocycles:** Preparation, properties, and uses of furan, thiophene, pyrrole and pyridine. Heterocycles present in RNA & DNA.
Unit II	**Stereochemistry:** Stereoisomerism – Definition and classification. Optical isomerism- chirality, chiral achiral, symmetric, asymmetric molecules. Enantiomers, diastereomers, racemate, racemization, resolution-specific rotation – meaning of (+) and (-) and d or 1 notation- lactic acid and tartaric acid - D & L

	configuration as applied to carbohydrates and amino acids – R-S configuration as applied to carbohydrates and amino acids – R-S configuration. Conformation – definition – conformational structure of ethane, cyclohexane, glucose, and fructose.
Unit III	**Coordination chemistry and bioinorganic chemistry:** Definition with examples of ligand, types- coordination number – coordination sphere – coordination compounds chelation-chelates. Bio- coordination compounds – hemoglobin, chlorophyll, metalbased drugs-cis-platin as anti-cancer drug-detoxification of metals by chelation therapy with respect to iron, aluminium, copper, mercury, arsenic and cadmium.
Unit IV	**Chemical kineties:** Rate and order of a reaction-determination of order of a reaction (Ostwald's isolation method), Homogeneous catalysis – basic aspects. Chemical thermodynamics: Laws of thermodynamics, energy, entropy, free energy concepts. **Chemical equilibrium:** Reversible and irreversible reactions- equilibrium constant and relationship between Kc & Kp-Lechatelier's principle and effects of change of concentration, temperature, and pressure.
Unit V	**Solutions:** Solution- definition-types –concentration of solutions (Molarity, Molality, Normality and Mole-fraction). **Electrochemistry:** Weak and strong electrolytes-Ostwald's dilution law-Lewis and Bronsted concepts of acids and bases. Ionic product of water-pH of solutions-pH scale – buffer solutions – importance of pH and buffer in biological systems.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	S
CO2	S	VS	VS	VS	VS
CO3	VS	VS	S	VS	VS
CO4	S	VS	S	VS	VS
CO5	S	VS	S	VS	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. B.S. Bahl and A. Bahl, *Advanced Organic Chemistry*, S. Chand & Company Ltd. 1st Edition, 2020.
2. P.L. Soni and M. Katyal, *Text book of Inorganic Chemistry*, Sultan Chand & Sons, 2006.
3. B.R. Puri, L.R. Sharma and M.S. Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co., 47th Edition, 2016.
4. B.R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers, 2012.

Related Online Contents:

1. Chapman and Hall, London, UK.
   http://www.cea.nic.in/index.html1

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SEMESTER - II

COURSE: ENVIRONMENTAL STUDIES

Course Code	BM12ES	Course Type	EVS	L	T	P	C	Syllabus version	2022-2023
				1	1	-	2		
Pre-requisite	Basic knowledge on Environment and Biology								

Course Objectives:

- To understand aware of various environmental issues.
- To gain knowledge on , Pollutions and control methods
- To gain knowledge on environment tools

Unit I

The Multidisciplinary Nature of Environmental Studies

Definition- Scope and Importance - Need for public awareness

Unit II

I. Natural Resources: Renewable and Non-Renewable Resources

Natural resources and associated problems

a. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people
b. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams - benefits and problems
c. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies
d. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies
e. Energy resources: Growing energy needs, Renewable and Non- renewable energy sources, use of alternate energy sources. case studies
f. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification

- Role of an individual in conservation of natural resources
- Equitable use of resources for sustainable lifestyles.

Unit III

II. Ecosystems

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem - Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem

a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem

d. Aquatic ecosystems (ponds, streams, lakes, rivers, ocean, estuaries)

Unit IV	**Biodiversity and its Conservation** • Introduction - Definition, genetic, species and ecosystem diversity • Biogeographically classification of India • Value of biodiversity - consumptive use, productive use, social, ethical aesthetic and option values • Biodiversity at global, national and local levels • India as a mega-diversity nation • Hot-spots of biodiversity • Threats to biodiversity - habitat loss, poaching of wildlife, man wildlife conflicts • Endangered and endemic species of India • Conservation of biodiversity - In-situ and Ex-situ conservation of biodiversity.
Unit V	**Environmental Pollution** Definition, Causes, effects and control measures of a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards • Solid waste Management: Causes, effects and control measures of urban and industrial wastes • Role of an individual in prevention of pollution - case Studies • Disaster management: floods, earthquake, cyclone and landslides - Ill effects of fireworks: Fireworks and celebrations, Health hazards, Types of fire, Fireworks and safety.
Unit VI	**Social Issues and the Environment** • From Unsustainable to Sustainable development • Urban problems related to energy • Water conservation, rain water harvesting, watershed management • Resettlement and rahabilitation of people; its problems and concerns- Case studies • Environmental ethics: Issues and possible solutions • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust - Case studies • Wasteland reclamation - Consumerism and waste products • Environment Protection Act • Air (Prevention and Control of Pollution) Act • Water (Prevention and control of Pollution) Act • Wildlife Protection Act • Forest Conservation Act • Issues involved in enforcement of environmental legislation • Public awareness
Unit VII	Human Population and the Environment • Population growth variation among nations • Population explosion - Family Welfare Programme

	• Environment and human health • Human Rights -Value Education • HIV/ AIDS- Women and Child Welfare • Role of Information Technology in Environment and human Health • Case Studies
Unit VIII	**Fieldwork** • Visit to a local area to document environmental assets-river/forest /grassland /hill /mountain • Visit to a local polluted site - Urban/Rural/Industrial/ • Agricultural Study of common plants, Insects, birds • Study of simple ecosystems-pond, river, hill slopes, etc.

Recommended References:

1. Abbasi, S.A. 1998. Environmental Chemistry, CBS publisher and Distributors, New Delhi.
2. Agarwal, K.C. 1995. Environmental Pollution and Law, Agro Botanical Publishers, New Delhi.
3. Baden Powell, B.H. 1997. A Manual of Forest Law. Biotech Books, New Delhi.
4. Barrow, C.J. 1999. Environmental Management-Principles and Practice. Routledge Publishers, London.
5. Centre for Environment Education 1997. Biodiversity, Oxford University Press, Delhi.
6. Cunningham, W. P., T. H. Cooper, E. Gorham and M, T. Hepworth, 1999. Environmental Encyclopedia, Jaico Publishing House, Mumbai.
7. Dara, S.S 1993, A Text*book of Environmental Chemistry and Pollution Control. Chand and Company Ltd., New Delhi.
8. DasGupta, A and A.N. Kapoor. 1999. Principles of Physical Geography, A Textbook of Physiography. S. Chand and company Ltd., RamNagar, New Delhi.
9. Gaur, G. 1997. Soil and Solid Waste Pollution and its Management. Sarup & sons, New Delhi.
10. Gerston. R. 1983. Just Open the Door: A Complete Guide to Experience Heywood, Y.H and Watson, R.T 1995. Global Biodiversity Assessment,
11. Cambridge Univ. Press.Hungerford, H.R. and T.L. VoIk. 1990 Changing Learner Beliaviour Through
12. Jeffry, A. Me Neely (1990) Conserving the Worlds Biological Diversity, IUCN.
13. Katval, T and M.Satake. 1998. Environmental Pollution. Anmol Publications Pvt Ltd., New Delhi.
14. Krishnan Karinan 1997 Fundamentals of Environmental Pollution Chand and Company Ltd, New Delhi.
15. Majupuria, T.C. 1986. Wildlife Wealth of India (Resources and Management). Tecpress Service, Bangkok, Thailand.
16. Mukherjee, S. and A. Ghosh. 2002. Environmental. Studies. Book and Allied
17. (P)Ltd., Calcutta.
18. Nago re, A. P. 1996. Biological Diversity and International Environmental Law A. P. H. Publishing Corporation, New Dehi. Pollution Control
19. Legislations, Vol-I and II. Tamil Nadu Pollution Control Board, Guindy, Chennai.

Related Online Contents:

2. Chapman and Hall, London, UK.
   http://www.cea.nic.in/index.html1

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பொதுத்தமிழ் -3

தமிழக வரலாறும் பண்பாடும்

இரண்டாம் ஆண்டு – மூன்றாம் பருவம்

Course Code	Course Name	category	L	T	P	S	Credits	Ins.Hrs	CIA	External	Total
BM23TL3A	பொதுத்தமிழ் -3 தமிழக வரலாறும் பண்பாடும்	Supportive	Y	-	-	-	3	6	25	75	100
Pre-Requisite		பன்னிரெண்டாம் வகுப்பில் தமிழை ஒரு பாடமாகப் பயின்றிருக்க வேண்டும்							SV 2023		

Learning Objectives

- தமிழக வரலாற்றை அறிந்துகொள்ளுதல்.
- தமிழரின் வாழ்வியல் தொன்மையை அறிதல்.
- தமிழரின் பண்பாட்டினை அறிந்துகொள்ளல்.
- தமிழர்மேல் நிகழ்ந்த பிற பண்பாட்டுத் தாக்கங்களை அறிதல்.
- தமிழ் இலக்கியம் சார்ந்த போட்டித் தேர்வுகளுக்கு ஏற்ப கற்பித்தல் நடைமுறைகளை மேற்கொள்ளுதல்

Expected Course Outcomes

On the Sucessful completion of the Course, Students will be able to

இப்பாடத்தைக் கற்பதால் பின்வரும் பயன்களை மாணவர் அடைவர்

CO 1	தமிழக வரலாற்றை அறிந்துகொள்வர்.	K4
CO 2	தமிழரின் வாழ்வியல் தொன்மையை அறிவர்.	K5, K6
CO 3	தமிழரின் பண்பாட்டுக் கூறுகளை அறிந்துகொள்வர்	K3
CO 4	பிற பண்பாட்டுத் தாக்கம் மற்றும் அணுகுமுறைகளை அறிவர்.	K3
CO 5	மொழிப்பயிற்சிக்குத் தேவையான இலக்கணங்களைக் கற்பர்.	K2

K1 - Remember; K2 - Undestand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

அலகு-1	தொல் பழங்கால வரலாறும் சங்ககால வரலாறும்

1. தொல் தமிழர்
2. பழைய கற்காலம்
3. புதிய கற்காலம்
4. உலோகக் காலம்
5. அகழ்வாராய்ச்சியில் தமிழும் தமிழரும் (கீழடி வரை)
6. திணை வாழ்வியல் (களவு வாழ்க்கை, கற்பு வாழ்க்கை, உணவு, அணிகலன்கள், வாணிகம்,விளையாட்டுகள்)

7. கல்வியும், கலைகளும்
8. தமிழ் வளர்த்த சங்கம்
9. சங்க கால ஆட்சி முறை

10 . அயல்நாட்டுத் தொடர்புகள்

அலகு-2	ஆட்சியர் வரலாறு

1. மூவேந்தர் வரலாறு
2. பல்லவர் வரலாறு
3. நாய்க்கர் ஆட்சி
4. முகம்மதியர் ஆட்சி
5. மராட்டியர் ஆட்சி

அலகு-3	ஐரோப்பியர் கால வரலாறு

1. போர்த்துக்கீசியர்
2. டச்சுக்காரர்கள்
3. டேனிஸ்காரர்கள்
4. பிரெஞ்சுக்காரர்கள்
5. ஆங்கிலேயர்கள்
6. பாளையக்காரர்கள்
7. இந்திய விடுதலைப் போராட்டத்தில் தமிழ்நாடு

அலகு-4	விடுதலைக்குபின் தமிழ்நாட்டு வரலாறு

7. மொழிப்போராட்டம்
8. சமூக மறுமலர்ச்சி
9. தொழில்நுட்ப வளர்ச்சி

அலகு-5	மொழிப்பயிற்சி

- நிறுத்தக் குறிகள்
- கலைச்சொற்கள்
- மொழிபெயர்ப்பு

பயிற்சி :ஆங்கிலக் கலைச் சொற்களைக் கொடுத்து அவற்றைத் தமிழில் மொழிபெயர்க்கச் செய்தல்.

Text books

- தமிழக வரலாறும் பண்பாடும் - கே.கே. பிள்ளை, உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை,
- தமிழர் நாகரிகமும் பண்பாடும் - அ. தட்சிணாமூர்த்தி, யாழ் வெளியீடு, சென்னை,.
- தமிழக வரலாறும் பண்பாடும் - வே.தி. செல்லம், மணிவாசகர் பதிப்பகம், சென்னை,
- ஆதிச்சநல்லூர் முதல் கீழடி வரை நுவேதா லூயிஸ், கிழக்குப் பதிப்பகம், சென்னை.
- பண்பாட்டு மானிடவியல் - பக்தவத்சல பாரதி, அடையாளம் பதிப்பகம், திருச்சி.
- .தமிழர் மேல் நிகழ்ந்த பண்பாட்டுப் படையெடுப்புகள், க.ப. அறவாணன், தமிழ்க்கோட்டம், சென்னை.

Reference Books

- தமிழக சமுதாய பண்பாட்டு கலை வரலாறு - கு. சேதுராமன், என்.சி.பி.எச், சென்னை,
- தமிழர் கலையும் பண்பாடும் - அ.கா. பெருமாள், என்.சி.பி.எச், சென்னை.
- ஒரு பண்பாட்டின் பயணம்: சிந்து முதல் வைகை வரை - ஆர். பாலகிருஷ்ணன், ரோஜா முத்தையா ஆராய்ச்சி நூலகம், சென்னை.
- தமிழும் பிற பண்பாடும் - தெ.பொ. மீனாட்சி சுந்தரனார், நியூ செஞ்சுரி புக் ஹவுஸ், சென்னை
- தமிழர் வரலாறும் பண்பாடும் - நீலகண்ட சாஸ்திரி, ஸ்ரீசெண்பகா பதிப்பகம், சென்னை
- தமிழர் வரலாறும் தமிழர் பண்பாடும் - மா.இராசமாணிக்கனார்
- தமிழர் நாகரிக வரலாறு - க.த.திருநாவுக்கரசு, தொல்காப்பியர் நூலகம், சென்னை.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

Web Sources

- https://www.chennailibrary.com/
- https://www.sirukathaigal.com
- https://www.tamilvirtualuniversity.org
- https://www.noolulagam.com
- https://www.katuraitamilblogspot.com

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
CLO 1	3	2	3	2	2	3	2	2	2	2	3	3
CLO 2	2	2	2	3	3	2	2	3	3	2	2	2
CLO 3	3	3	3	2	2	3	3	2	3	3	3	3
CLO 4	3	2	3	3	3	3	2	2	2	2	3	2
CLO 5	2	2	3	3	2	2	3	3	2	3	3	2

Strong -3,Medium-2,Low-1

SEMESTER - III

LANGUAGE COURSE- 3: COMMUNICATION IN FRENCH III

Course Code	BM23FL3	Course Type	Language	L	T	P	C	Syllabus version	2022-2023
				2	1	-	3		
Pre-requisite	Basic knowledge on General French								

Course Objectives:

- To broaden the horizons of learning French.
- To strengthen learners' reading and writing skills.
- To enable the learners communicate effectively in simple daily situations.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Cultivates the confidence to read, comprehend and translate short texts.	K1, K2
CO2	• Enhances the learners' acquisition of language skills in French.	K2
CO3	• Promotes interpersonal communicative skills.	K2, K3
CO4	• Enriches the learners' knowledge of the French culture and civilization.	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Describing in detail a person Describing in detail a place and an event Comparative structures Superlative structures Cultural life in France – Drama, cinema, and music Modes of payment in France **Practicum:** Reading aloud, communication in class, conjugation of verbs.
Unit II	Narrating a story Narrating an event in the past Relative pronouns Possessive pronouns Historical sites in France Unemployment in France Practicum: Dictation, learning new vocabulary, researching on French culture and civilization.

Unit III	Exchanging personal and professional information Comparing and appreciating Demonstrative pronouns Direct and indirect speech Social security in France Sports and celebrities Practicum: Web learning - stories, constructing/ translating sentences, learning vocabulary, writing dialogues.
Unit IV	Expressing one's opinion Applying for a job Conjugation of verbs – Past perfect Past historic Politics of France Recipes of French cuisine Practicum: Effective communication, effective writing, language lab activities, language games.
Unit V	Arguing, justifying Expressing certainty, uncertainty, possibility and impossibility Writing a bio-data Present participle Gerund France and the work place Shopping in France Practicum: Making a presentation, writing well structured paragraphs, impromptu speaking, story-telling activity, discussing and debating
(Current contours)	Celebrities of France Gastronomy of France Attractions of France Virtual trip to different regions of France Celebrated literary works

Recommended References:

1. Cocton Marie-Noëlle et al, *Saison 2*, Les Éditions Didier, Paris, 2015.
2. Mérieux Régine, Loiseau Yves, *Latitudes 2*, Les Éditions Didier, Paris, 2008.
3. Cocton Marie-Noëlle et al, *Génération 2*, Les Éditions Didier, Paris, 2010.
4. Poisson-Quinton et al, *Festival 2*, CLE International, Paris, 2005.
5. Girardet, Jacky, Pécheur J, *Écho 2*, CLE International, Paris, 2013.
6. Berthet, Hugot et al, *Alter Ego 2*, Hachette, Paris, 2012.
7. Mérieux Régine, Loiseau Yves, *Connexions 2*, Les Éditions Didier, Paris, 2011.
8. Girardet Jacky, Cridlig Jean-Marie, *Panorama 2*, CLE International, Paris, 2004.
9. Claire Miquel, *Communication Progressive du Français*, CLE International, Paris, 2004.
10. Girardet Jacky, Pécheur Jacques, *Campus 2*, CLE International, Paris, 2002.
11. Madanagobalane et al, *Synchronie 2*, Samhita Publications, Chennai, 2011.
12. Dominique, Philippe et al, *Le Nouveau Sans Frontières 2*, CLE International, Paris, 2011

Related Online Contents:

1. https://upload.wikimedia.org/wikipedia/commons/6/63/French.pdf
2. http://www.learnfrenchathome.com/magazine/say-it-book/Sample-Live-Like-a-French-Person.pdf
3. https://www.babbel.com/learn-french-online/65391-beginner%27s-courses
4. https://www.loecsen.com/en/learn-french
5. http://www.bbc.co.uk/languages/french/guide/phrases.shtml

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SEMESTER - III

LANGUAGE COURSE -3: ENGLISH FOR PROFICIENCY DEVELOPMENT I

Course Code	BM23EL3	Course Type	LANGUAGE	L	T	P	C	Syllabus version	2022-2023
				2	1	-	3		
Pre-requisite	Basic knowledge on General English								

Course Objectives:

- To help learners enhance their interpretative skills
- To enable learners to put the language skills into practice

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Capability in reading, interpreting and comprehending the text into English.	K1, K2
CO2	• Transforming and narrating real life stories in English.	K2
CO3	• Developing language skills and engaging in a range of communicative tasks and activities.	K1, K2
CO4	• Ability to write sentences grammatically.	K3
CO5	• Communicating with appropriate grammatical forms	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Module 1 R. K. Narayan – Malgudi Days Anita Desai – Where Shall We Go This Summer? Practicum:
Unit II	Module 2 Expressions of Introduction, Apologizing, Advising, Asking Directions, Giving Instructions, Agreeing and Disagreeing and Recommendations Practicum: Communicative tasks in various modes of expressions.

Unit III	Module 3 Auxiliary verb, -ing and Infinitive, Articles, Nouns, Pronouns, Determiners, Relative Clauses Adverbs, Adjectives, Conjunctions, Prepositions, Phrasal Verbs, Writing Business letter – Letter of Quotation and Invitation, Essay Writing Practicum: Constructing new sentences using various grammatical groups of words.
Unit IV	Module 4 Present Continuous, Present Simple, Past Simple, Past Continuous, Present Perfect and Past Perfect, Past Perfect Continuous, Future, Modals, Conditionals and Wish, Passive, Reported Speech, Question Practicum: Framing sentences expressing various tenses.
Current Contours	**(For Continuous Internal Assessment only)** Essentials of grammar in the digital era-grammaticality in Social Media-practical application of the prosody of English language-language demands of the 21st century.

Recommended References:

1. Murphy, Raymond. Intermediate English Grammar: Reference and Practice for South Asian Students with Answers. Cambridge: Cambridge UP, 1994. Print. (Module III & IV)
2. Taylor, Grant. English Conversation Practice. New Delhi: Tata McGraw-Hill, 2004. Print. (Module II)
3. Pillai, G. Radhakrishna and K. Rajeevan. Spoken English for You Level 1. New Delhi: Emerald Publishers, 2008. Print.

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SEMESTER - III

CORE COURSE -3: BIOCHEMISTRY

Course Code	BM23C3	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basics of cellular macromolecules and metabolism								

Course Objectives:

- To educate basic aspects of chemistry, properties and physiological importance of water, buffers and significance of acid-base balance in body fluids.
- To learn the concept of bioenergetics and the mechanism of biological oxidation.
- To understand the chemistry, functions and metabolism of macromolecules such as carbohydrates, proteins, nucleic acids and lipids.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the concept of bioenergetics, respiratory chain reactions and the mechanism of oxidative phosphorylation.	K1, K2
CO2	• Illustrate the classification, properties, biological role of carbohydrates and glucose metabolism.	K1
CO3	• Describe the classification, properties, functions and metabolism of proteins and amino acids.	K1, K2
CO4	• Explain the structure and functions of nucleic acids (DNA and RNA), nucleotides and metabolism of purine and pyrimidine nucleotides.	K1, K3
CO5	• Comprehend the structure, properties, biological functions and classification of lipids and metabolism of fatty acids.	K1, K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Structure and properties of water. Concept of pH, pOH and buffers. Buffer system in body fluids and acid-base balance. Henderson-Hasselbatch equation - derivation and its application. Bioenergetics-Laws of thermodynamics, standard free energy, enthalpy, and entropy. Exergonic and endergonic reactions. Role of high energy compounds. Biological oxidation – enzyme complexes of electron transport chain (ETC), respiratory chain reactions and oxidative phosphorylation. Inhibitors of ETC and uncouplers of oxidative phosphorylation.

Unit II	Carbohydrates: Classification, structure, properties and biological functions. Biologically important monosaccharides and disaccharides – structure, properties and significance. Polysaccharides – types, structure, and biological importance. Homo and hetero polysaccharides (mucopolysaccharides) and proteoglycans. Metabolism of carbohydrates - Glycolysis, Citric acid cycle, Glycogenesis, Glycogenolysis, Gluconeogenesis and regulation.
Unit III	Proteins and amino acids: Classification, composition and properties of proteins. Amino acids – structure, properties and classification. Peptides, polypeptide and synthesis of peptide bonds. Levels of organization of protein structure. Ramachandran plot. Metabolism of amino acids – catabolism of carbon skeletons of amino acids - glucogenic and ketogenic amino acids. Transamination, deamination, decarboxylation and detoxification of ammonia. Urea cycle and regulation.
Unit IV	Nucleic acids: Structure of purines and pyrimidine bases. Nucleosides, nucleotides, nucleic acids and nucleoproteins and their biological significance. Structure, types and functions of DNA. Structures of double helices, Watson and Crick model. Physical properties of DNA – Buoyant density, viscosity, hypochromicity, denaturation and renaturation. Cot curve and C-value paradox. RNA types, structure and functions. Biosynthesis of purine and pyrimidine nucleotides (*de novo* and salvage pathway). Degradation of purine and pyrimidines.
Unit V	Lipids: Classification and properties. Structure and functions of fatty acids, triacyl glycerol, phospholipids, sphingolipids, glycolipids and sterols. Role of lipoproteins in biological system. Metabolism of triglycerides and phospholipids. Biosynthesis of saturated and unsaturated fatty acids. Oxidation of fatty acids (α, β and γ oxidation). Overview on cholesterol biosynthesis and degradation.
Current Contours	**(Not for Final Exam, only for Discussion)** Introduction to enzymes – classification and catalytic properties. Metabolic disorders of carbohydrates, amino acids and lipids. Advancement in metabolic profiling of biological samples.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	VS	M	S
CO2	VS	M	VS	VS	VS
CO3	VS	VS	S	M	VS
CO4	VS	M	S	M	M
CO5	S	M	M	VS	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Nelson, David L., & Cox, M. M. (2021). *Lehninger principles of biochemistry,* (8th ed.). W. H. Freeman. USA.
2. Murray, R. K., Bender, D. A., Botham, K. M., Kennelly, P. J., Rodwell, V. W., & Weil, P. A. (2022). *Harper's Illustrated Biochemistry,* (32nd ed.). The McGraw-Hill Companies, Inc. USA.
3. Voet, D., & Voet, J. G. (2010). *Biochemistry,* (4th ed.). John Wiley & Sons.
4. John Tymoczko, J. M., & Berg Lubert Stryer, G. (2019). *Text Book of Biochemistry*, (9th ed.). W.H. Freeman & Co. USA.
5. Satyanarayana, U., & Chakrapani, U. (2013). *Biochemistry,* (4th ed.). Elsevier and Books and Allied (P) Ltd. India.
6. Bhagavan, N. V. (2002). *Medical Biochemistry,* (4th ed.). Academic Press Inc.
7. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2023). *Textbook of Biochemistry for Medical Students.* (10th ed.). Jaypee Brothers Medical Publishers (P) Ltd. New Delhi.

Related Online Contents:

1. https://www.ncbi.nlm.nih.gov/books/NBK526105/
2. https://doi.org/10.1038/emm.2015.122
3. https://www.ncbi.nlm.nih.gov/books/NBK26821/

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SEMESTER - III

LABORATORY COURSE -3: BIOCHEMISTRY

Course Code	BM23CP3	Course Type	Laboratory course	L	T	P	C	Syllabus version	2022-2023
				1	-	3	3		
Pre-requisite	Basic knowledge on Properties of biomolecules								

Course Objectives:

- To impart thorough knowledge on different solutions and reagent preparation for chemicalmeasurements.
- To perform the qualitative test of carbohydrates and amino acids.
- To quantify the amount of reducing sugars, amino acids and proteins in the sample.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Prepare various types of solutions and buffers for the laboratory tests.	K3, K5
CO2	• Standardize the solutions for the biochemical assays.	K4
CO3	• Identify the presence of biochemical constituents by qualitative tests.	K4
CO4	• Quantify the concentration of biomolecules using standard method.	K7
CO5	• Apply biochemical techniques in their laboratory and industrial research.	K3, K6
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Experiments

List of Practical:

1. Different concentration of solutions - Normality (N), Molarity (M) and Percentage (%) solutions.
2. Calculation and preparation of various Normal, Molar and Percentage solutions and makingdilutions.
3. Preparation of stock solutions and working standards for quantitative estimation.
4. Preparation of buffer solutions.
5. Training to use weighing balance and pH meter.
6. Qualitative Analysis of Carbohydrates: Glucose, Fructose, Ribose, Galactose, Lactose, Maltose, Sucrose and Starch. Identification of both monosaccharides and disaccharides in mixtures.

7. Qualitative Analysis of Amino acids: Tyrosine, Tryptophan, Arginine, Cysteine, methionine and Histidine.

8. Quantitative Analysis:
   a) Estimation of amino acid by Ninhydrin method.
   b) Determination of reducing sugar (Total Carbohydrate) by Anthrone method
   c) Determination of protein by Lowry's method.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	M	S	S	VS
CO2	VS	S	VS	M	S
CO3	VS	VS	S	M	VS
CO4	VS	M	M	S	VS
CO5	S	S	S	VS	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry*, (2nd ed.). New Age International. New Delhi.
2. Plummer, D. T. (2004). *Introduction to practical biochemistry*, (3rd ed.). McGraw-Hill Education Pvt. Ltd. New Delhi.
3. Kumar, A., Sarika, G., & Neha, G. (2012). *Biochemical Tests: Principles and Protocol.* Viva Books Pvt. Ltd. New Delhi.
4. Sadasivam, S., & Manickam, A. (2006). *Biochemical Methods.* New Age International. New Delhi.
5. Sawhney, S. K. (1996). *Introductory Practical Biochemistry*. Narosa Publishing House Pvt. Ltd. Kolkata.

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SEMESTER - III

ALLIED COURSE -3: PHYSICS

Course Code	BM23AC3	Course Type	Allied	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on Physics								

Course Objectives:

• To explain nuclear properties, radiation physics and study bio medical applications of radiation.
• Describe the fluid property surface tension; ST occurs whenever there is an interface between a liquid, a solid or a gas. Study the Osmosis and applications.
• To obtain a general knowledge of the basic principles of biological systems.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• The role of nuclear Physics in applications such as radioactivity and nuclear reactions shall be understood.	K1, K2
CO2	• Students understand the concept of osmosis and understand the importance of osmosis in plant and animal cells.	K1, K2
CO3	• Be able to explain Bio-medical application of radiation and general biological systems.	K3
CO4	• Identify and analysis the electromagnetic radiation.	K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Mechanics and Elasticity : Newton's laws of motion – Applications – Collision – Impulse – Projectile motion p Centrifugal force – Centripetal force – Applications – Elasticity – Stress – Strain – Elastic modulus : Young's modulus – Bulk modulus –Modulus of rigidity – Relation between elastic constants – Bending of beams – Cantilever.
Unit II	Fluid Statics and Dynamics: Surface tension – Capillary rise – Water rise in tall trees – Variation of surface tension with temperature – Osmosis – Laws of osmosis – Hartley and Berkeley experiment – Viscosity – Viscosity of liquid – Poiscuille's formula- Viscosity of blood – Flow of liquid through tubes Bernoulli's equation – Venturimeter.
Unit III	Atomic and Molecular Physics: Electromagnetic spectrum – Rotation and vibration of molecules – Absorption and emission spectra – Basic elements of practical spectroscopy – Absorption and emission Spectrometer (block diagram) – NMR spectroscopy.

Unit IV	**Radiation Physics:** Atomic nucleus – Isotopes – Radioactivity - Radioactive decay and half – life – Disintegration – Decay products- Biological traces – Positive ions, electrons, and X-rays, γ-rays – GM counter - Interaction of electromagnetic radiation with matter – Biological effect of Radiation – Dosimetry – Basic definitions and units of radiation.
Unit V	**Biomacromolecules:** Proteins: Amino acids – Peptide bond – Cis and Trans configurations – Torsion angles – Phi and Psi – Steric hindrance – Conduct criteria – Ramachandran diagram, Maps for glycine and alanine residues o Classification of proteins into globular and fibrous – Levels of structural organization**.** **Nucleic Acids**: Nucleosides and nucleotides – Structure of DNA – Watson and Crick model – Base paring and base stacking – Variations in DNA structure – Polymorphism – A, B and Z – DNA. **Carbohydrates:** Classification – L and D sugars – Monosaccharide – Disaccharides – Types of linkages in polysaccharides – structure of maltose, celloboise and lactose – Ramanchandran map for disaccharides.
Current Contours	**(Skill development exercise - NOT for Final Examination)** 1. Determination of Plateau and resolving time of a GM Counter and its application is estimating the shelf-ratio and activity of a beta source. 2. Find out the young's and rigidity modulus of materials. And calculate surface tension of the different liquids.

Recommended References:

1. R. Murugesan, Modern Physics, S. Chand & Company Ltd (1998) New Delhi.
2. Mookerjee & Sukhendu B. Bhattacharjee, Aspects of Radiation Biophysics, Interprint, New Delhi.
3. C.N. Banwell, Fundamentals of Molecular Spectroscopy (Mc Graw Hill, New York, 1981).
4. Brij Lal, N. Subramanmiyan, Jivan Seshan Mechanics and Electrodynamics, Eurasia Publishing House (PVT.) Ltd. 1980.
5. Lehnlinger, D. L Nelson and M. M. Cox. Principles of Biochemistry, CBS Publishers, New Delhi (1993).
6. Lubert Stryer, Biochemistry, W. H. Freeman and Co., New York (1995).
7. V. S. R. Rao, P. K. Qasba, P. V. Balajil and R. Chandrasekaran Conformation of Carbohydrates Harwood Academic Publishers, Amsteerdam (1998).

Related Online Contents:

1. https://archive.org/details/mechanicsandprop029174mbp

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SEMESTER - III

NME: IMMUNOLOGY

Course Code	BM23NM1	Course Type	NME	L	T	P	C	Syllabus version	2022-2023
				2	1	-	2		
Pre-requisite	Knowledge on basics of cell biology								

Course Objectives:

- To provide knowledge on essential features of antigens and antibodies.
- To Imparts knowledge on the types of immunity and immune responses.
- To educate on the diseases associated with immune responses.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend on the immunity and components of immune system	K1, K2
CO2	• Know the factors determining immunogenicity	K1
CO3	• Understand the types of immunity and immune responses	K1, K2
CO4	• Educate on various types of immune mediated reactions	K2, K4
CO5	• Apprehend on immunological tolerance and its importance	K2, K7
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	**Introduction:** Scope of Immunology, Historical background of Immunology, Innate and Adaptive Immunity, components of the Immune System-organs and cells, Humoral and Cell-mediated Immunity.
Unit II	**Antigens and Antibodies:** Immunogens and Antigens, Factors Determining Immunogenicity, Epitopes, Antibodies and Variants- Isotypes and its functions, Polyclonal and Monoclonal Antibodies.
Unit III	**Immune Response:** Primary and Secondary Antibody Response. Immunity to Viruses, Bacteria, Types of Immunity-Passive and Active, Types of Vaccines-Vaccines in Current Use and In Development, Adjuvants and Booster doses.
Unit IV	**Disorders of Immune system:** Brief overview on – Primary & Secondary Immunodeficiency disorders. Brief overview on Hypersensitivity reactions**:** Types of Hypersensitivity Reactions: IgE mediated Immediate (Type-I) Hypersensitivity, Cytotoxic (Type-II) Hypersensitivity, Immune Complex mediated (Type III) Hypersensitivity. Cell Mediated (Type IV) or Delayed type

	Hypersensitivity.
Unit V	**Immune Tolerance and Transplantation:** Brief overview on Self – tolerance & Breakdown of self-tolerance –autoimmunity, types of autoimmune Disease with few examples. Define – Transplantation, Types of Grafts, Brief overview on major transplantation Antigen -HLA, Post transplantation Immune mediated complication- Graft Rejection. Immunosuppressive Drugs.
Current Contours	**(Not for Final Exam, only for Discussion)** Principle of antigen and Antibody Interactions. Immunological techniques and its uses in disease diagnosis.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	S
CO2	VS	S	VS	M	VS
CO3	VS	VS	VS	S	M
CO4	VS	VS	M	VS	VS
CO5	VS	S	VS	S	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2019). Basic Immunology 6th Edition, Elsevier.
2. Delves PJ, Martin SJ, Burton DR, and Ivan M. Roitt (2017). Roitt's Essential immunology- 13th Edition.
3. Raj Khanna. (2011). Immunology, Oxford University Press.

Related Online Contents:

1. https://doi.org/10.1016/j.vaccine.2010.07.022

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SEMESTER - III

NME: MEDICAL GENETICS

Course Code	BM23NM3	Course Type	NME	L	T	P	C	Syllabus version	2022-2023
				2	1	-	2		
Pre-requisite	Knowledge on basic cell and molecular biology								

Course Objectives:

- To offer basic knowledge on genetics and inheritance
- To educate on the relationship between phenotype and genotype
- To impart knowledge on the importance of human genetics and disease association.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend knowledge on genetics and inheritance	K3
CO2	• Know the organization of the genome.	K1
CO3	• Understand the nature of the inheritance of genes and diseases	K1, K2
CO4	• Understand various types of DNA damage and Genetic Abnormalities.	K2
CO5	• Learn cytogenetics and molecular approaches for disease diagnosis	K7
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	History of Genetics Pre- Mendelian concepts; Mendel and his experiments: Law of segregation, Law of independent assortment. Backcross and Testcross; Concepts of Phenotype and Genotype; Molecular organization of DNA in chromosomes.
Unit II	Concepts of genome organization - split genes, overlapping genes, unique sequences, repetitive sequences, pseudogenes, Transposons, conserved genes.

Unit III	History of human genetics, pedigree symbols, construction of pedigrees, Monogenic traits, Autosomal inheritance-dominant, recessive Sex-linked inheritance, Sex-limited and sex-influenced traits, Mitochondrial inheritance.
Unit IV	DNA damage, Mutations; kinds of mutation; agents of mutation; Numerical and structural aberrations (translocations, duplications, deletions, microdeletion, fragile sites), Chromosomal disorders. Common syndromes due to numerical changes and structural disorders.
Unit V	History and development of Human Cytogenetics, Idiogram, Karyotyping, Chromosome banding techniques, Cytogenetic nomenclature, sister chromatid exchanges, FISH Comparative, Genomic Hybridization (CGH).
Current Contours	**(Not for Final Exam, only for Discussion)** Human Genome Project, Next Generation Sequencing, Precision Medicine.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	S	VS	VS	S
CO3	VS	VS	VS	S	M
CO4	VS	VS	M	VS	VS
CO5	VS	S	VS	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Turnpenny PD, Ellard S, Cleaver R. (2020). Emery's Elements of Medical Genetics and Genomics: Emery's Elements of Medical Genetics E-Book. Elsevier Health Sciences.
2. Cohn R, Scherer S, Hamosh A, editors. (2023). Thompson & Thompson Genetics and Genomics in Medicine E-Book: Thompson & Thompson Genetics and Genomics in Medicine E-Book. Elsevier Health Sciences.

Related Online Contents:

1. https://www.hugo-international.org/online-courses/

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SEMESTER – III

HEALTH & WELLNESS

Course Code	BM23HM	L	T	P	C
		0	0	2	1

Skill Areas:

Physical Fitness, Nutrition, Mental Health, Awareness on Drug addiction and its effects

Purpose:

The Health & Wellness course focuses on teaching the elements of physical, mental, emotional, social, intellectual, environmental well-being which are essential for overall development of an individual. The course also addresses the dangers of substance abuse and online risks to promote emotional and mental health.

Learning Outcomes:

Upon completion of the Health & Wellness course, students will be able to:

1. Demonstrate proficiency in sports training and physical fitness practices.
2. Improve their mental and emotional well-being, fostering a positive outlook on health and life.
3. Develop competence and commitment as professionals in the field of health and wellness.
4. Awareness on drug addiction and its ill effects

Focus:

During the conduct of the Health & Wellness course, the students will benefit from the following focus areas:

1. Stress Management.
2. Breaking Bad Habits.
3. Improving Interpersonal Relationships.
4. Building Physical Strength & Inner Strength.

Role of the Facilitator:

The faculty plays a crucial role in effectively engaging with students and guiding them towards achieving learning outcomes. Faculty participation involves the following areas:

1. **Mentorship & Motivation:** The Facilitator mentors students in wellness and self-discipline while inspiring a positive outlook on health. Faculty teach stress management, fitness, and daily well-being.
2. **Promoting a Safe and Inclusive Environment:** The facilitator ensures a safe, inclusive, and respectful learning environment for active student participation and benefit.
3. **Individualised Support and Monitoring Progress:** The facilitator plays a crucial role in providing personalized support, monitoring and guidance to students.

Guided Activities:

In this course, several general guided activities have been suggested to facilitate the achievement of desired learning outcomes. They are as follows:

1. Introduction to Holistic Well-being.
2. Holistic Wellness Program- Nurturing Body and Mind
3. Breaking Bad Habits Workshop.
4. Improving the elements of physical, emotional, social, intellectual, environmental and mental well-being.
5. Creating situational awareness, digital awareness.
6. Understanding substance abuse, consequences and the way out.

Period Distribution

The following are the guided activities suggested for this Audit course.

The Physical Director should plan the activities by the students.

Arrange the suitable Mentor / Guide for the wellness activities.

Additional activities and programs can be planned for Health and Wellness.

S.No	Guided Activities	Period
1	**Introduction to Holistic Well-being** 1. Introduce the core components of Health & Well-being namely Physical, mental and emotional well-being 2. Provide worksheets on all the four components individually and explain the interconnectedness to give an overall understanding.	
2	**Wellness Wheel Exercise (Overall Analysis)**	

	• Guide students to assess their well-being in various life dimensions through exercises on various aspects of well – being, and explain the benefits of applying wellness wheel. • Introduce Tech Tools: • Explore the use of technology to support well-being. • Introduce students to apps for meditation, sleep tracking, or healthy recipe inspiration.	
3	**Breaking Bad Habits (Overall Analysis)** • Open a discussion on bad habits and their harmful effects. • Provide a worksheet to the students to identify their personal bad habits. • Discuss the trigger, cause, consequence and solution with examples. • Guide them to replace the bad habits with good ones through worksheets.	
4	**Physical Well-being** **1. Fitness** Introduce the different types of fitness activities such as basic exercises, cardiovascular exercises, strength training exercises, flexibility exercises, so on and so forth. (Include theoretical explanations and outdoor activity). **2. Nutrition** Facilitate students to reflect on their eating habits, their body type, and to test their knowledge on nutrition, its sources and the benefits. **3. Yoga & Meditation** Discuss the benefits of Yoga and Meditation for one's overall health. Demonstrate different yoga postures and their benefits on the body through visuals (pictures or videos)	

	4. Brain Health Discuss the importance of brain health for daily life. Habits that affect brain health (irregular sleep, eating, screen time). Habits that help for healthy brains (reading, proper sleep, exercises). Benefits of breathing exercises and meditation for healthy lungs. **5. Healthy Lungs** Discuss the importance of lung health for daily life. Habits that affect lung health (smoking, lack of exercises). Benefits of breathing exercises for healthy lungs. **6. Hygiene and Grooming** Discuss the importance of hygienic habits for good oral, vision, hearing and skin health. Discuss the positive effects of grooming on one's confidence level and professional growth. **<u>Suggested Activities (sample):</u>** **Nutrition:** Invite a nutritionist to talk among the students on the importance of nutrition to the body or show similar videos shared by experts on social media. Organize a 'Stove less/fireless cooking competition' for students where they are expected to prepare a nutritious dish and explain the nutritive values in parallel.	
5	**Emotional Well-being** **1. Stress Management** Trigger a conversation or provide self-reflective worksheets to identify the stress factors in daily life and their impact on students' performance. Introduce different relaxation techniques like deep breathing, progressive muscle relaxation, or guided imagery. (use audio recordings or visuals to guide them through these techniques). After practicing the techniques, have them reflect on how these methods can help manage stress in daily life. **2. Importance of saying 'NO'.**	

	Explain the students that saying 'NO' is important for their Physical and mental well-being, Academic Performance, Growth and Future, Confidence, Self-respect, Strong and Healthy Relationships, building reputation for self and their family (avoid earning a bad name). Factors that prevent them from saying 'NO'. How to practice saying 'NO". **3. Body Positivity and self-acceptance** Discuss the following with the students. • What is body positivity and self-acceptance? • Why is it important? • Be kind to yourself. • Understand that everyone's unique. **Suggested Activities(Sample):** (Importance of saying 'NO') Provide worksheets to self-reflect on... ...how they feel when others say 'no' to them ...the situations where they should say 'no' Challenge students to write a song or rap about the importance of saying no and how to do it effectively. Students can perform their creations for the class.	
6	**Social Well-Being** **1. Practicing Gratitude** Discuss the importance of practicing gratitude for building relationships with family, friends, relatives, mentors and colleagues. Discuss how one can show gratitude through words and deeds. Explain how practicing gratitude can create 'ripple effect'. **2. Cultivating Kindness and Compassion** Define and differentiate between kindness and compassion. Explore practices that cultivate these positive emotions. Self-Compassion as the Foundation.	

	The power of small gestures. Understanding another's perspective. The fruits of compassion. **3. Practising Forgiveness** Discuss the concept of forgiveness and its benefits. Forgiveness: What is it? and What it isn't? Benefits of forgiveness. Finding forgiveness practices. **4. Celebrating Differences** Appreciate the value of individual differences and foster inclusivity. The World: A Tapestry of Differences (cultures, backgrounds, beliefs, abilities, and appearances). Finding strength in differences (diverse perspectives and experiences lead to better problem-solving and innovation). Celebrating differences, not ignoring them (respecting and appreciating the unique qualities). Activities for celebrating differences (share culture, learn about others, embrace new experiences). **5. Digital Detox** **Introduce the students to:** The concept of a digital detox and its benefits for social well-being. How to disconnect from devices more often to strengthen real-world connections. **Suggested Activities (sample):** (Practicing Gratitude) Provide worksheets to choose the right ways to express gratitude. Celebrate 'gratitude day' in the college and encourage the students to honour the house keeping staff in some way to express gratitude for their service.	
7.	**Intellectual Well-being** **1. Being a lifelong Learner** **Give students an understanding on:** The relevance of intellectual well-being in this 21st century to meet	

	the expectations in personal and professional well-being The Importance of enhancing problem-solving skills Cultivating habits to enhance the intellectual well-being (using the library extensively, participating in extra-curricular activities, reading newspaper etc.) **2. Digital Literacy** **Discuss:** The key aspects of digital literacy and its importance in today's world. It is more than just liking and sharing on social media. The four major components of digital literacy (critical thinking, communication, problem-solving, digital citizenship). Why is digital literacy important? Boosting one's digital skills. **3. Transfer of Learning** Connections between different subjects – How knowledge gained in one area can be applied to others. **Suggested Activities(sample):** Intellectual Well-being. Provide worksheets to students for teaching them how to boost intellectual well-being. Ask the students to identify a long-standing problem in their locality, and come up with a solution and present it in the classroom. Also organize an event like 'Idea Expo' to display the designs, ideas, and suggestions, to motivate the students to improve their intellectual well-being.	
8	**Environmental Well-being** 1.The Importance of initiating a change in the environment. **The session could be around:** Defining Environmental well-being (physical, chemical, biological, social, and psychosocial factors) – People's behaviour, crime, pollution, political activities, infra-structure, family situation etc. Suggesting different ways of initiating changes in the environment (taking responsibility, creating awareness, volunteering,	

	approaching administration). **Suggested Activities (sample):** Providing worksheets to self-reflect on how the environment affects their life, and the ways to initiate a change. Dedicate a bulletin board or wall space (or chart work) in the classroom for students to share their ideas for improving environmental well-being. Creating a volunteers' club in the college and carrying out monthly activities like campus cleaning, awareness campaigns against noise pollution, (loud speakers in public places), addressing anti-social behaviour on the campus or in their locality.	
9	**Mental Well-being** **1. Importance of self-reflection** Discuss: Steps involved in achieving mental well-being (self-reflection, self-awareness, applying actions, achieving mental well-being). Different ways to achieve mental well-being (finding purpose, coping with stress, moral compass, connecting for a common cause). The role of journaling in mental well-being. **2. Mindfulness and Meditation Practices** Benefits of practicing mindful habits and meditation for overall well-being. **1. Connecting with nature** Practising to be in the present moment – Nature walk, feeling the sun, listening to the natural sounds. Exploring with intention – Hiking, gardening to observe the nature. Reflecting on the emotions, and feeling kindled by nature. **2. Serving people** Identifying the needs of others. Helping others. Volunteering your time, skills and listening ear. Finding joy in giving. **3. Creative Expressions**	

	Indulging in writing poems, stories, music making/listening, creating visual arts to connect with inner selves. **Suggested Activities(Sample):** (Mindfulness and Meditation) – Conducting guided meditation every day for 10 minutes and directing the students to record the changes they observe.	
10	**Situational Awareness (Developing Life skills)** **1. Being street smart** Discuss: Who are street smarts? Why is it important to be street smart? Characteristics of a street smart person: Importance of acquiring life skills to become street smart – (General First-aid procedure, CPR Procedure, Handling emergency situations like fire, flood etc). **2. Digital Awareness** **Discuss:** Cyber Security Information Literacy Digital Privacy Fraud Detection **Suggested Activities** (sample): (Street Smart) Inviting professionals to demonstrate the CPR Procedure Conducting a quiz on Emergency Numbers	
11	**Understanding Addiction** **Plan this session around:** Identifying the environmental cues, triggers that lead to picking up this habit. Knowing the impact of substance abuse – Adverse health conditions, social isolation, ruined future, hidden financial loss and damaging the family reputation. Seeking help to get out of this addiction. **Suggested Activities**:	

	Provide Worksheets to check the students' level of understanding about substance addiction and their impacts. Share case studies with students from real-life. Play/share awareness videos on addiction/de-addiction, experts talk. *Conduct awareness programmes on Drugs and its ill effects. (Arrange Experts from the concerned government departments and NGOs working in drug addiction issues) and maintain the documents of the program.	

Closure:

Each student should submit a Handwritten Summary of their Learnings & Action Plan for the future.

Assessments:

- Use Self-reflective worksheets to assess their understanding.
- Submit the worksheets to internal audit/external audit.
- Every student's activities report should be documented and the same have to be assessed by the Physical Director with the mentor. The evaluation should be for 100 marks. No examination is required.

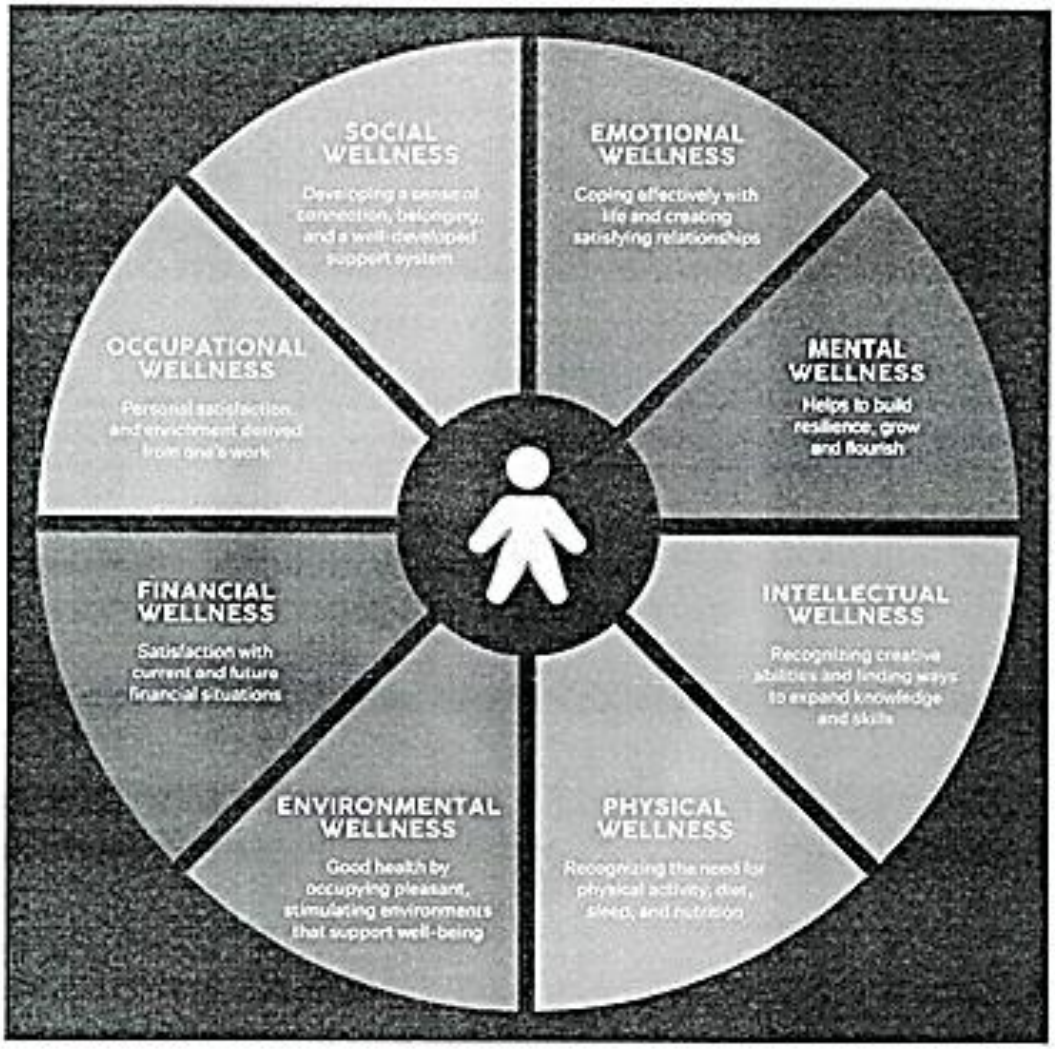
Scheme of Evaluation

Part	Description	Marks
A	Report	40
B	Attendance	20
C	Activities (Observation During Practice)	40
Total		100

References/Resource Materials:

The course acknowledges that individual needs for references and resources may vary. However, here are some general reference materials and resources that may be helpful:

1. **The Well-Being Wheel:**



2. **Facilities & Spaces:** Some activities may require access to specific facilities, resources or spaces. Students may need to coordinate with the college administration to reserve these as required.
3. **Online Resources:**
    1. United Nations Sustainable Development Goals - Goal 3 - Good Health & Well-Being: https://www.un.org/sustainabledevelopment/health/
    2. Mindfulness and Meditation: Stanford Health Library offers mindfulness and meditation resources: https://healthlibrary.stanford.edu/books-resources/mindfulness-meditation.html

3. Breaking Bad Habits: James Clear provides a guide on how to build good habits and break bad ones: https://jamesclear.com/habits
4. 6 Ways to Keep Your Brain Sharp https://www.lorman.com/blog/post/how-to-keep-your-brain-sharp
5. What Is Social Wellbeing? 12+ Activities for Social Wellness https://positivepsychology.com/social-wellbeing/
6. How Does Your Environment Affect Your Mental Health? https://www.verywellmind.com/how-your-environment-affects-your-mental-health-5093687
7. How to say no to others (and why you shouldn't feel guilty) https://www.betterup.com/blog/how-to-say-no

பொதுத்தமிழ் -4

தமிழும் அறிவியலும்

இரண்டாம் ஆண்டு – நான்காம் பருவம்

Course Code	Course Name	category	L	T	P	S	Credits	Ins.Hrs	CIA	External	Total
BM24TL4A	பொதுத்தமிழ் -4 தமிழும் அறிவியலும்	Supportive	Y	-	-	-	3	6	25	75	100
Pre-Requisite		பன்னிரெண்டாம் வகுப்பில் தமிழை ஒரு பாடமாகப் பயின்றிருக்க வேண்டும்							SV 2023		

Learning Objectives

- தாய்மொழி வழியாக அறிவியல் பற்றிய சிந்தனைகளை வளர்த்தல்.
- அறிவியல் கலைச் சொல்லாக்கம் பற்றிப் பயிற்றுவித்தல்.
- மாணவர்களுக்கு அறிவியல் பார்வையை ஏற்படுத்துதல்.
- தமிழில் அறிவியல் படைப்பிலக்கியங்களை உருவாக்கத் தூண்டுதல்
- தமிழ் இலக்கியம் சார்ந்த போட்டித் தேர்வுகளுக்கு ஏற்ப கற்பித்தல் நடைமுறைகளை மேற்கொள்ளுதல்

Expected Course Outcomes

On the Sucessful completion of the Course, Students will be able to

இப்பாடத்தைக் கற்பதால் பின்வரும் பயன்களை மாணவர் அடைவர்

CO 1	தாய்மொழி வழியாக அறிவியல் பற்றிச் சிந்திக்கும் திறன் பெற்றிருப்பர்.	K4
CO 2	அறிவியல் கலைச் சொல்லாக்கம் பற்றிய விதிகள், நுணுக்கங்களைத் தெரிந்திருப்பர்.	K5, K6
CO 3	அறிவியல் தமிழ் வளர்ச்சியில் மொழிபெயர்ப்பின் பங்கு குறித்து அறிந்திருப்பர்.	K3
CO 4	மொழியறிவோடு சிந்தனைத்திறனைப் பெறுவர்	K3
CO 5	மொழிப்பயிற்சிக்குத் தேவையான இலக்கணங்களைக் கற்பர்.	K2

K1 - Remember; K2 - Undestand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

அலகு-1	தமிழரின் அறிவியல் சிந்தனைகள்

- அறிவியலும் மனித வாழ்வும்
- ஐந்திணைப் பகுப்பும் சூழலியலும்
- தொழில்நுட்ப மேலாண்மை
- நீர் நில மேலாண்மை

அலகு-2	பழந்தமிழ் இலக்கியங்களில் அறிவியல் சிந்தனைகள்

1. நிலவியல்
2. உலோகவியல்

3. வானவியல்
4. உயிரியல்
5. உளவியல்

அலகு-3	இடைக்கால இலக்கியங்களில் அறிவியல் சிந்தனைகள்

1. காப்பியங்களில் அறிவியல்
2. சிற்றிலக்கியங்களில் அறிவியல்
3. உரைநூல்களில் அறிவியல்

அலகு-4	இணையத் தமிழ்

1. இணையத் தமிழ் பயன்பாடு - அறிமுகம்
2. இணையத்தமிழ்க் கல்விக்கழகம்
3. இணைய நூலகம்
4. செயற்கை நுண்ணறிவியல்
5. தமிழ்நாட்டு அறிவியல் ஆளுமைகள்

அலகு-5	கடிதம் எழுதுதலும் கட்டுரை எழுதுதலும்

- உறவு முறைக் கடிதப் பயிற்சி
- அலுவலகக் கடிதப் பயிற்சி
- விண்ணப்பப் படிவம் எழுதும் பயிற்சி
- தன் விவரப் படிவம் எழுதும் பயிற்சி
- கருத்து விளக்கக் கட்டுரைகள் எழுதும் பயிற்சி
- த்திரிகைகளுக்குக் கட்டுரை எழுதும் பயிற்சி

Text books

- அறிவியல் தமிழ் இன்றைய நிலை - இராதா செல்லப்பன், உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை.
- மணவை முஸ்தபா, தமிழில் அறிவியல் படைப்பிலக்கியம், மணவை பப்ளிகேஷன், சென்னை.
- கலைச்சொல்லாக்கம் - மங்கை, ரங்கராசபுரம், சென்னை .
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Reference Books

1.தமிழர் வேளாண்மை மரபுகள் - இல).செ.கந்தசாமி

- 2. சங்க இலக்கியத்தில் வேளாண் சமுதாயம், பெ.மாதையன், நியூ செஞ்சுரி புக் ஹவுஸ்

3. தமிழில் அறிவியல் இதழ்கள்சாமுவேல்- ரா.பார்வேந்தன் ஃபிஷ்கிறீன் பதிப்பகம், கோவை

4. அறிவியல் தமிழ் - பதிப்பாசிரியர் இராதா செல்லப்பன்,பாரதிதாசன் பல்கலைக்கழகம், திருச்சிராப்பள்ளி.

5. இணையத் தமிழ் வரலாறு, மு.பொன்னவைக்கோ, பாரதிதாசன் பல்கலைக்கழகம்

6. இணையத் தமிழ், சந்திரிகா சுப்பிரமணியம் - சந்திரோதயம் பதிப்பகம்

7. இணையமும் இனிய தமிழும் - துரை. மணியரசன், இசை பதிப்பகம்

8. கணினித் தமிழ், இல. சுந்தரம் - விகடன் பிரசுரம்

9. மாண்புமிகு மண், பாமயன், வம்சி புக்ஸ்

10. தமிழ் இலக்கியத்தில் அறிவியல் சிந்தனைகள் வானதி பதிப்பகம், சென்னை

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

Web Sources

- https://www.chennailibrary.com/
- https://www.sirukathaigal.com
- https://www.tamilvirtualuniversity.org
- https://www.noolulagam.com
- https://www.katuraitamilblogspot.com

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
CLO1	3	2	3	3	3	2	2	2	3	2	3	2
CLO2	3	3	2	2	2	3	2	3	3	2	2	2
CLO3	3	2	3	3	2	2	2	3	2	3	3	2
CLO4	3.	3	3	2	2	2	3	2	3	2	3	3
CLO5	3	3	2	2	2	3	3	2	2	2	3	3

Strong -3,Medium-2,Low-

SEMESTER - IV

LANGUAGE COURSE- 4: COMMUNICATION IN FRENCH IV

Course Code	BM24FL4	Course Type	Language	L	T	P	C	Syllabus version	2022-2023
				2	1	-	3		
Pre-requisite	Basic knowledge on General French								

Course Objectives:

- To enhance learners' acquisition of advanced French.
- To enable the learners communicate effectively.
- To augment the learners' awareness of the land, people and culture of France.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Enables the students to be proficient and communicate with confidence.	K1
CO2	• Promotes interpersonal communicative skills	K2
CO3	• Enhances the employability skills of the learners	K1, K2
CO4	• Enriches the learners' knowledge of the French culture and civilization.	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Expressing emotions, regrets and indifference Describing hypothetical or imaginary situations Subjunctive present Conjugation of pronominal verbs- Past tense Tourism in France Literature – Contemporary writers of France **Practicum:** Reading aloud, Communication in class, conjugation of verbs.
Unit II	Expressing plans, dreams and aspirations Asking for information and giving information Active and passive voice Conjugation of verbs – Conditional present Science and technology The French and their vacation **Practicum:** Dictation, learning new vocabulary, researching on French culture and civilization.

Unit III	Expressing fear and suspicion Discussing one's likings and preferences Construction with two pronouns Conjugation of verbs – Conditional past Conjugation of verbs – Future perfect Dreams and values of the French Sharing household work – Attitude of the French **Practicum:** Web learning - stories, constructing/ translating sentences, learning vocabulary, writing dialogues.
Unit IV	Description of objects and persons Seeking advice and advising Indefinite pronouns Subjunctive – present and past Drafting advertisements The French and their health Fairy tales of France **Practicum:** Effective communication, effective writing, language lab activities, language games.
Unit V	Reserving a table, ordering food and appreciating Lodging a complaint Interrogative pronouns Conditional past Tatooing in France Superstitions in France **Practicum:** Making a presentation, writing well structured paragraphs, impromptu speaking, story-telling activity, discussing and debating.
(Current contours)	Learning French through songs Revisiting fairy tales What are francophone countries? Celebrated francophone authors Wonders of the French regions

Recommended References:

1. Cocton Marie-Noëlle et al, *Saison 2*, Les Éditions Didier, Paris, 2015.
2. Mérieux Régine, Loiseau Yves, *Latitudes 2*, Les Éditions Didier, Paris, 2008.
3. Cocton Marie-Noëlle et al, *Génération 2*, Les Éditions Didier, Paris, 2010.
4. Poisson-Quinton et al, *Festival 2*, CLE International, Paris, 2005.
5. Girardet, Jacky, Pécheur J, *Écho 2*, CLE International, Paris, 2013.
6. Berthet, Hugot et al, *Alter Ego 2*, Hachette, Paris, 2012.
7. Mérieux Régine, Loiseau Yves, *Connexions 2*, Les Éditions Didier, Paris, 2011.
8. Girardet Jacky, Cridlig Jean-Marie, *Panorama 2*, CLE International, Paris, 2004.
9. Claire Miquel, *Communication Progressive du Français*, CLE International, Paris, 2004.
10. Girardet Jacky, Pécheur Jacques, *Campus 2*, CLE International, Paris, 2002.
11. Madanagobalane et al, *Synchronie 2*, Samhita Publications, Chennai, 2011.
12. Dominique, Philippe et al, *Le Nouveau Sans Frontières 2*, CLE International, Paris, 2011

Related Online Contents:

1. https://www.thefrenchexperiment.com/learn-french
2. http://www.bbc.co.uk/languages/french/guide/phrases.shtml
3. https://www.rocketlanguages.com/french/learn/learn-french-online
4. https://www.rosettastone.com/languages/french-words/
5. https://www.mondly.com/french-phrases-expressions
6. http://www.learnfrenchathome.com/magazine/say-it-book/Sample-Live-Like-a-French-Person.pdf

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SEMESTER - IV

LANGUAGE COURSE -4: ENGLISH FOR PROFICIENCY DEVELOPMENT II

Course Code	BM24EL4	Course Type	LANGUAGE	L	T	P	C	Syllabus version	2022-2023
				2	1	-	3		
Pre-requisite	Basic knowledge on General English								

Course Objectives:

- To help learners to strengthen their communication skills
- To make learners improve their writing skills for their career development

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Usage of various sentence structures	K1, K2
CO2	• Ability to improve comprehensive writing	K2
CO3	• Communicating with appropriate grammatical forms	K3
CO4	• Ability to correct sentence grammatically	K2, K3
CO5	• Ability to write effectively and professionally using appropriate vocabulary	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Module 1 Communication – Types of Communication- Importance of Communication- Verbal and Non- Verbal Communication – Barriers of Communication – Group Communication – Presentation Skills-Interview Skills-Group Discussion Practicum: Conducting mock-interview, mock-GD and mock presentations.
Unit II	Module 2 Writing Reports, Resume, Proposals, e-mails Practicum: Writing different types and forms of Reports, Resume, Proposals, e-mails

Unit III	Module 3 Nouns and Compounds, Articles, Determiners and Quantifiers, Relative Clauses and other types of clause, Pronoun, Substitution and Leaving out words, Adjectives, Adverbs and Conjunction, Prepositions, Organizing Information Practicum:
Unit IV	Module 4 Tenses, Modals – Be, have, do, make- Passives, Questions, Verb, Infinitives, -ing forms, Reporting Practicum: Constructing new sentences using various grammatical groups of words.
Current Contours	**(For Continuous Internal Assessment only)** Present job requirements-global job market needs-life skills and professional communication – recent demands in various professional jobs.

Recommended References:

1. Hewings, Martin. Advanced English Grammar: A Self Study Reference and Practice Book for Advanced South Asian Students with Answers. New Delhi: Cambridge UP, 1999. Print. (Module III & IV)
2. Raman, Meenakshi and Sangeeta Sharma. Technical Communication: Principles and Practice. Oxford UP. New Delhi, 2011.Print. (Module I & II)

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SEMESTER - IV

CORE COURSE -4: PRINCIPLES OF GENETICS

Course Code	BM24C4	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on DNA structure and replication								

Course Objectives:

- To gain knowledge on the laws and patterns of Genetic Inheritance.
- To understanding the methods involved in Genetic analysis.
- To gain insights on genetic abnormalities and their impact on diseases.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend the importance of Genetics.	K2
CO2	• Describe various principles of inheritance.	K1, K2
CO3	• Illustrate the genetic abnormalities associated with diseases	K3
CO4	• Understand the methods involved in screening of genetic diseases.	K7
CO5	• Describe various gene therapeutic strategies.	K2, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Introduction to Genetics, Mendel and the laws of inheritance, Cellular and Molecular Basis of Inheritance - Chromosome structure, Mutations and Mutagenesis. Chromosomes – Human chromosome, chromosome nomenclature, chromosomal abnormalities.
Unit II	Patterns of inheritance – family studies, Population genetics – Allele frequencies, gene polymorphism, segregation analysis, genetic linkage. Polygenic and multifactorial inheritance heritability and multifactorial disorders. Gene mapping and identification of human diseasegenes.

Unit III	Clinical Genetics – Congenital abnormalities and dysmorphic syndromes, Genetic counseling, Chromosomal breakage syndromes. Single gene disorders – Huntington disease, neurofibromatosis, cystic fibrosis, cardiomyopathies, Duchenne muscular dystrophy and Hemophilia, Genetic instability.
Unit IV	Screening of diseases – carrier testing, population screening and genetic registers. Probability theory, Autosomal dominant/recessive inheritance, Bayes‟ theorem and empiric risks.
Unit V	Gene Therapy-Ex-vivo and in vivo gene therapy, Gene delivery systems (i) viral and (ii) non-viral. Ethical issues in medical genetics.
Current Contours	**(Not for Final Exam, only for Discussion)** Cytogenetic testing, Chromosomal Translocations, Genetic analysis using family histories.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	S	VS	S	S
CO3	VS	VS	VS	S	VS
CO4	S	S	VS	M	S
CO5	VS	VS	S	VS	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Pranab Paul. (2021). *Principles of Genetics. Mahaveer Publications*, 1st Edition;
2. Klug WS, Cummings MR, Spencer CA, Palladino MA, Killian D. (2019). Concepts of Genetics, Global Edition. Person.
3. Snustad DP, Simmons MJ. (2015). Principles of genetics. John Wiley & Sons;
4. Brooker, R.J. (2015). Genetics: Analysis & Principles, 6th Ed.

Related Online Contents:

1. https://doi.org/10.1016/j.shpsc.2010.11.016
2. https://onlinecourses.swayam2.ac.in/cec21_bt02/preview
3. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/223

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SEMESTER - IV

ALLIED COURSE -4: MICROBIOLOGY

Course Code	BM24AC4	Course Type	Allied	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Fundamental knowledge on microbes								

Course Objectives:

- To learn the history, basic concepts and recent developments in microbiology.
- To know the bacterial anatomy and microbial identification methods.
- To study the structural organization, microbial genetics, bacterial growth, nutritional requirements of bacteria.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Know the history, basic concepts and recent developments in Microbiology.	K1, K2
CO2	• Know the bacterial anatomy and microbial identification methods.	K5
CO3	• Learn the structural organization, microbial genetics, bacterial growth, nutritional requirements of bacteria.	K2
CO4	• Acquire information on nutritional requirements of bacteria and include environmental factors involved in microbial growth.	K5
CO5	• Understand the gene transfer methods in microbial genetics.	K3, K7
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	History, scope and its recent developments in Microbiology – Spontaneous generation – Biogenesis – Contribution of Leeuwenhoek – Louis Pasteur – John Tyndall – Joseph Lister – Robert Koch. Microscopy – light microscopy – simple & compound, dark-field, phase contrast, fluorescence and electron microscopy. Binomial nomenclature of microbes.

Unit II	Sterilization principle – dry heat, moist heat, filtration, pasteurization, radiation. Disinfection- Antimicrobial chemotherapy, antibiotics, sources, mode of action, test for sensitivity to antimicrobial agents and its quality control.
Unit III	Bacterial anatomy – cell wall, capsule, flagella, pili, sporulation – structure and function. Culture techniques- types of media, preparation of media. Enumeration of bacteria by Plate and MPN method. Preservation of culture. Microbial identification – pure culture, morphological, physiological and biochemical properties.
Unit IV	Nutritional requirements of bacteria, autotrophs, heterotrophs. Bacterial growth curve. The influence of environmental factors on microbial growth – water activity, pH, temperature, O2 concentration, pressure, radiation. Potable water treatment; Sewage (waste water) treatment – Primary, secondary and tertiary treatment.
Unit V	Microbial genetics – Plasmids - conjugation, transformation and transduction. Applied microbiology – Recombinant vaccines, Biofertilizers (Rhizobium, BGA, Mycorrhizae), Biopesticides, Vitamins, Hormones (Insulin, Thyroxine, Human growth hormone).
Current Contours	**(Not for Final Exam, only for Discussion)** Understanding market research before launching of any consumer products, understanding success stories of clinical trials before launching of Biofertilizers and Antibiotics in market.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	VS
CO2	VS	S	S	VS	VS
CO3	VS	VS	S	VS	VS
CO4	VS	VS	VS	M	S
CO5	VS	S	S	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Pelczar,A Jr M.J. Chan and Kreig, N.R. (2021). Microbiology, Mc Graw Hill,Inc, NewYork.
2. Ananthanarayan R. and C.K. Jeyaram Panikar. (1994). Textbook of Microbiology. Orient Longman
3. Frazier, W.C. and Westhoff, D.C. (1988). Food Microbiology. 4th Edition.McGraw Hill, NY.
4. Atlas, R. and Bartha R. (1992). Microbial Ecology: Fundamental andApplications. 2nd Edition. Englewood. C.A.Benjamin/cummings.
5. Subbha Rao, N.S. (1995). Biofertilizers in Agriculture and Forestry. 3rd Ed.Oxford & IBH Pub.Co, Press.
6. Connie R. Mahon , Donald C. Lehman. (2023). Textbook of Diagnostic Microbiology**,** 7th Edition, ISBN-10:032382997X, ISBN-13: 978-0323829977, Elsevier - Health Sciences Division Publisher.
7. Ananthanarayan and Paniker's. (2023). Text book of Microbiology, 12th Edition. Universities
8. Press Private Ltd., ISBN: 978-93-93330-01-7.
9. Subhash Chandra Parija. (2024). Textbook of Microbiology and Immunology, 4th Edition. ISBN: 9789819992614, Springer Verlag Publishers.
10. C P Baveja, V Baveja. (2024). Microbiology at A Glance, 1st Edition. Arya Publishing Company Publishers.
11. Denise G. Anderson Lecturer, Sarah Salm, Mira Beins (2024). Nester's Microbiology: A Human Perspective, 11th Edition, ISBN - 10 :1266867554, ISBN- 13: 978-1266867552.
12. R. C. Dubey and D. K. Maheshwari. (2024). A Textbook of Microbiology, 5th Edition, ISBN: 978-93-550-1527-3.

Related Online Contents:

1. https://www.sciencedirect.com/journal/microbiological-research
2. https://digitalcommons.unl.edu/bioscimicro/
3. https://scholar.google.co.in/scholar?q=microbiology+related+research+papers&hl=en&as_sdt=0&as_vis=1&oi=scholart
4. https://www.mdpi.com/1660-4601/7/10/3657
5. https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-019-1483-4

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SEMESTER – IV

LABORATORY COURSE -4: MICROBIOLOGY

Course Code	BM24AP1	Course Type	Laboratory Course	L	T	P	C	Syllabus version	2022-2023
				1	-	3	3		
Pre-requisite	Basic knowledge on microbes and microscopy								

Course Objectives:

- To know the basic information on enumeration of bacteria from environment and clinical samples.
- To learn the culture techniques for maintenance of pure culture.
- To identify the bacteria up to genus level by using biochemical characterization.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Perform the collection and processing of the sample of microbes.	K2
CO2	• Examine the conditions required for the maintenance of pure cultures.	K1, K2
CO3	• Accomplish the growth curve for the bacteria.	K5
CO4	• Detect all types of the MPN method.	K1, K2
CO5	• Demonstrate the various staining methods to screen of microbe and Analyse Biochemical Methods	K2, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Experiments

1. Preparation and cleaning of glass wares
2. Collection and processing of samples for bacteriological analysis
3. Preparation and sterilization of bacteriological media.
4. Enumeration of bacteria by
   - Pour plate method
   - Spread plate method
5. Pure culture technique
   - Phase streaking
   - Continuous streaking
6. Estimation of total coliform bacteria by MPN technique
   - Presumptive test
   - Confirmed test
   - Completed test

7. Smear preparation
8. Simple staining
9. Gram staining or differential staining
10. Negative staining
11. Detection of Catalase and Oxidase enzymes
12. Citrate Utilization test
13. Oxidation and fermentation test
14. Antibiotic sensitivity test – Disc diffusion test
15. Motility test- Hanging drop technique

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	S	S	VS
CO2	VS	VS	VS	VS	VS
CO3	VS	VS	VS	M	VS
CO4	S	VS	VS	VS	S
CO5	S	VS	VS	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Joanne Willey, Kathleen Sandman and Dorothy Wood. (2023). Prescott's Microbiology, 12 th Edition, ISBN10: 1264088396, ISBN13: 9781264088393.
2. Beatrix Fahnert, Phoebe Lostroh. (2023). Strelkauskas Microbiology a clinical approach, 3 Edition, ISBN-10: 1032043474, ISBN-13: 978-1032043470. Taylor & Francis Publisher Ltd.
3. Denise G. Anderson Lecturer, Sarah Salm, Mira Beins. (2024). Nester's Microbiology: A Human Perspective, 11th Edition. ISBN - 10 :1266867554, ISBN-13: 978-1266867552.

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SEMESTER - IV

NME: HUMAN PATHOLOGY

Course Code	BM24NM2	Course Type	NME	L	T	P	C	Syllabus version	2022-2023
				2	1	-	2		
Pre-requisite	Basic knowledge on cell biology								

Course Objectives:

- To gain the knowledge on various types of human diseases.
- To educate the diagnostic methods , treatments and prevention of diseases
- To provide the basics on the histological slide preparation of healthy and diseased tissues.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Describe the basics of disease pathogenesis	K1
CO2	• Know the techniques used in pathology	K1
CO3	• Understand the importance of staining.	K1, K2
CO4	• Define infectious and non-infectious diseases.	K2
CO5	• Identify and define medical terminology used in pathology	K2, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Cellular responses to injury, Acute inflammation, Healing and Repair, Chronic inflammation, infections of histological importance, Amyloidosis, disorders of growth, Neoplasia, Atherosclerosis, Thrombosis, Embolism and Infarction.
Unit II	Cardiovascular system, Respiratory system, Alimentary system, Hepatobility system and Pancreas, Urinary system, lymphoid and Haemopoietic system.

Unit III	Female reproductive system, breast, male reproductive system, Endocrine system, Skin, Skeletal system and Nervous system.
Unit IV	Microtome, Fixation of tissues, Dehydration, Clearing, Embedding and sectioning.
Unit V	Routine staining of section and stained sections- Decalcification and staining of bone, staining of organisms, parasites and fungi in sections, histological methods for nervous system, Cryo sections in histopathological analysis.
Current Contours	**(Not for Final Exam, only for Discussion)** Digital Pathology: Whole-Slide Imaging, Artificial Intelligence (AI). Pathology Informatics, Electronic Health Records (EHR), Data Integration, Understanding Disease Mechanisms: Single-Cell Analysis, Pathogen Genomics. Immunohistochemistry and Immuno-oncology: Targeted Therapies: Biomarker Discovery. Genomic and Molecular Pathology: Liquid Biopsy, Next-Generation Sequencing (NGS).

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	M
CO2	VS	S	VS	VS	VS
CO3	VS	S	S	S	S
CO4	S	VS	M	VS	VS
CO5	VS	VS	VS	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Alans Stevens, James S. Lowe and Barbara Young. (2002). Wheater's Basic Histopathology, 4th Edition, Churchill Livingtone pub.
2. Charles F. A. Culling, T. A. Hyde, Martin J. Inwood, Leslie D. Mellor, F. Sergovich, Frank Spencer, Sam Thomson. (1976). Lynch's Medical Laboratory Technology, 3rd Edition, W.B. Saunder Company (Section 3 only).

Related Online Contents:

1. https://www.hopkinsmedicine.org/health/conditions-and-diseases/atherosclerosis
2. https://www.sciencedirect.com/topics/physics-and-astronomy/human-pathology

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SEMESTER - IV

NME: FORENSIC SCIENCE

Course Code	BM24NM4	Course Type	NME	L	T	P	C	Syllabus version	2022-2023
				1	1	-	2		
Pre-requisite	Basic knowledge on chemistry and human biology								

Course Objectives:

- To educate on the importance of physical/biological evidences encountered in crime scene investigation.
- To create awareness about various crime matters and advance techniques in crime detection.
- To generate talented human resource in the area of forensic problem solving

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the History of Forensic science and its significant role in judicial system	K2
CO2	• Understand some of the basic facts, concepts and principles relating to the physical and morphological identification	K1, K2
CO3	• Describe the principles and significance of crime scene protection and investigation.	K4
CO4	• Demonstrate the procedure of superimposition	K2
CO5	• Understand the role of crime scene reconstruction in crime investigation	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Forensic Science: Definition, History and Development- Identification: Age (From physical morphological features, Dentation, Estimation of age from bones), Determination of sex from bones-Forensic importance of hair- Forensic Science Laboratories - DFSS, SFSL, CFSLs, NCRB & NICFS
Unit II	Crime Scene examination: Documentation of crime scene - Recognition, Collection, Preservation of physical& trace evidences - Types of crime scene search- Crime Scene Photography- Superimposition- Lie detection (Polygraphy)- Track marks and Bite marks- Tachographs- Cyber Forensics

Unit III	Finger prints: Classification, Preservation, Development, Lifting and Comparison, Automated Fingerprint Identification System (AFIS), Importance of finger prints-Lip prints (Cheiloscopy), iris and retina-Examination of biological fluids: Blood, Seminal and Saliva- Sexual offences and its medicolegal importance, Disputed Paternity & Maternity.
Unit IV	Cause and Mechanism of Death: Unnatural deaths, Thermal and electrical exposure, Asphyxial deaths, Infanticide, Criminal assaults, Poisoning, Vehicular accidents -Changes after Death: Immediate changes, Early changes, Late changes. Autopsy: Aims and objectives of conducting autopsy- Artefacts.
Unit V	Forensic Toxicology: Introduction, Narcotic drugs - Alcoholic beverages, Licit and illicit liquors, Classification of poisons: corrosive poisons: Sulphuric acid, HCL, Carbolic acid, Oxalic acid -Metallic poisons: Lead, Arsenic, Mercury- Irritant poisons: Organic Irritants, Snake venom, Inorganic irritants (Phosphorus, Chlorine, Bromine), Mechanical irritants (powdered glass)-Food poisoning-Dope tests.
Current Contours	**(Not for Final Exam, only for Discussion)** Concept of brain death and its relevance.- Medico – legal aspects of: Potency and impotency, Legitimacy and Paternity , Virginity, Pregnancy and Abortion- Battered Baby Syndrome- Sexual exploitation of girl children – age and criminal responsibility – Relevant sections or pares in Indian Penal Code- Drugs and psychotropic substances.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	VS
CO2	VS	VS	S	M	S
CO3	VS	S	VS	VS	VS
CO4	VS	VS	M	S	S
CO5	S	VS	VS	VS	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. P. C. Dikshit. (2013). Text book of Forensic Medicine and Toxicology- PEEPEE Publishers
2. V.V. Pillay. (2023). Text book of Forensic Medicine and Toxicology- Paras medical Publishers
3. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's. (2013) Techniques of Crime Scene Investigation, CRC Press, Boca Raton.
4. Lee and Gaensleen's. (2013) Advances in Fingerprint Technology, 3rd Edition, R.S. Ramotowski (Ed.), CRC Press, Boca Raton.
5. Rattan Lal and Dhiraj Lal. (2019). The Indian Penal code. 28th edition.
6. Saurabh Shukla, Sakshum Khanna, Tahir Ul Gani Mir, Jyoti Dalal, Deeksha Sankhyan, Kushagra Khanna. (2024). Emerging global trends and development in forensic toxicology: A review, Journal of Forensic and Legal Medicine, Volume 103, 102675, ISSN 1752-928X, https://doi.org/10.1016/j.jflm.2024.102675.

Related Online Contents:

1. https://nicfs.gov.in/nicfs/
2. https://ncrb.gov.in/en

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SEMESTER - V

CORE COURSE -5: MOLECULAR BIOLOGY

Course Code	BM35C5	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on cell biology and biomolecules								

Course Objectives:

- To provide an overview of molecular biology and its core principles in central dogma of life.
- To impart basics properties of Nucleic acids, DNA replication, repair & recombination
- To learn the detailed mechanism of transcription and translation for Prokaryotes and eukaryotes.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the central dogma of life in the cell	K2
CO2	• Correlate the nucleic acid structure and properties	K1, K2
CO3	• Demonstrate DNA is the Universal genetic material	K1
CO4	• Describe the principles of DNA replication in prokaryotic and eukaryotic cells	K2
CO5	• Explain the molecular mechanisms behind DNA damage and DNA-repair systems	K1, K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Structure and Properties of Nucleic acids: Nucleic acid as the genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment)- Components of DNA and RNA -Watson and Crick model of DNA structure, Various forms of DNA- Physical properties of nucleic acids; Denaturation and renaturation, Cot curves – Structure and function of mRNA, rRNA, tRNA- Chromatin structure- Euchromatin, Heterochromatin- Central Dogma of Molecular Biology.

Unit II	Replication: Principle and mechanism of replication- Conservative, Semi conservative, Uni- directional and bi-directional mode of replication- Enzymes and accessory proteins involved in replication- Prokaryotic and Eukaryotic DNA replication. DNA damage& repair (Direct repair systems, mismatch repair system, base excision repair and recombination repair).
Unit III	Transcription: Concept of transcription, RNA polymerases, transcriptional factors, regulatory elements, Mechanism of transcription in Prokaryotes and eukaryotes, Distinction between prokaryotic and eukaryotic transcription. Concept and mechanism of post transcriptional modification- 5‟ capping, polyadenylation, splicing of nuclear pre-mRNA, nuclear export of mRNA- mRNA stability.
Unit IV	Genetic code: Characteristics, Wobble hypothesis- Translation (*prokaryotes and Eukaryotes*): Ribosome structure and assembly, Activation of amino acid, Aminoacyl tRNA synthetases, Mechanism of protein synthesis (Initiation, Elongation and Termination), Post translational processing of proteins.
Unit V	Regulation of gene expression (*Prokaryotes& Eukaryotes*): Principles of transcriptional regulation, *cis* acting elements and *trans* acting factors- Operon model (inducible systems like *lac*- operon, *arabinose* operon and repressible systems like *trp* operon), Riboswitch - Role of chromatin in regulating gene expression and gene silencing-Enhancers, Repressors, Insulators, Gene amplification & rearrangements, Transposons, RNA processing and editing.
Current Contours	**(Not for Final Exam, only for Discussion)** Key discoveries in molecular biology- Genome sequencing tools-Gene expression and analyzing methods-Synthetic genome -Future of molecular biology in medicine.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	S	VS	S	VS	S
CO3	VS	VS	VS	VS	VS
CO4	VS	VS	M	VS	VS
CO5	VS	S	VS	S	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. (2002). Molecular biology of the Cell. Garland publishing Inc
2. Lehninger's. (2008). Principles of Biochemistry, Publisher: W. H. Freeman; ISBN: 071677108X
3. Darnell, Lodish and Baltimore. (2002). Molecular Cell Biology, Scientific American Publishing Inc, 4. Genes VIII- by Benjamin Lewin, Oxford University Press, Nelson Cox.
4. T. A. Brown. (2017). Genome 4, Garland Science publishers
5. E.D.P. De Robertis, E. M. F. De Robertis. Jr. (2010). Cell and Molecular Biology, Eight edition, Wolters Kluwer India.
6. Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M, Losick. R. (2008). Molecular Biology of Gene. The Benjamin / Cummings Pub. Co. Inc.
7. Ajoy Paul. (2011). Text book of Cell and molecular biology.
8. Rastogi, S.C. (2004). Cell Biology, 2nd Edition, New Age International Publishers, New Delhi.
9. Randall H. Morse. (2023). Chapter 8 - Chromatin and transcription, Editor(s): Randall H. Morse.

Related Online Contents:

1. https://www.sanfoundry.com/molecular-biology-questions-answers-genome-organization-1/
2. Chromatin, Academic Press, 2024, Pages 443-563, ISBN 9780128148099, https://doi.org/10.1016/B978-0-12-814809-9.00009-3.

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SEMESTER - V

CORE COURSE -6: IMMUNOLOGY

Course Code	BM35C6	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on human physiology and cell biology								

Course Objectives:

- To gain knowledge on organization of immune system and its functions.
- To understand the immune responses against infections.
- To explain the immune responses against non-infectious pathological conditions.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the organization of Immune system and its components.	K2
CO2	• Comprehend the role of Immune system in conferring protection from infectious diseases.	K1, K2
CO3	• Know the facts about the effective role of adaptive immune system over innate immune system	K4
CO4	• Describe effector mechanisms and effector molecules of immune responses	K3
CO5	• Relate failure of regulation of immune responses with the pathogenesis of autoimmune diseases and hypersensitivity reactions.	K1, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Organs of the immune system – Primary and secondary lymphoid organs- Types of immunity – Innate and acquired immunity. Innate immunity – Cellular components - Phagocytic cells, inflammatory cells and NK cells, Acquired immunity- Cellular components of adaptive immune system – T cells - B lymphocytes –lymphocytes trafficking between lymphoid tissues. Recognition molecules and receptors of innate immune systems - PAMPs, CD1 molecule and MBL (mannose binding lectins) - Pattern recognition receptors (PRRs), TLRs, KIR, Fc gamma receptors (FcγRIa, FcγRIIa and FcγRIIIa)- Complement receptors. Recognition molecules and receptors of adaptive immune systems - MHC molecules- genomic map of MHC genes, cellular distribution and expression, Antigen processing and presentation – the cytosolic pathway and endocytic pathway- Receptors of adaptive immune system – TCR and BCR.

Unit II	Hematopoiesis– T and B lymphocytes ontogeny and development, Activation and Effector mechanism of innate immune system – Phagocytosis - Respiratory burst - inflammation, T lymphocyte activation and downstream signaling following activation. Granzyme and perforin pathways, Fas-FasL pathway, T cell and B cell interaction - B cell activation and downstream signaling following activation and Immunoglobulin class switching. Complement mediated cytotoxicity and Antibody dependent cytotoxicity (ADCC).
Unit III	Antigens – Factors influence immunogenicity, Epitopes, haptens – Effector molecules of innate system -Acute phase proteins, complements- classical & alternative pathways of complement system. Effector molecules of cell-mediated and humoral immune responses - cytokines - Properties, receptors and antibodies / Immunoglobulins – Structure, antigenic determinants, immunoglobulin classes and functional significances.
Unit IV	Immune response to infectious agents & hypersensitivity reactions. Overview on immunity to intracellular and extracellular pathogens-Bystander damage caused by the immune response to infection- evasion of immune responses by various infectious agents. Overview on hypersensitivity reactions – Gell and Coombs classification, IgE-mediated (Type I), antibody- mediated (Type II), immune complex- mediated (Type III) (Glomerulonephritis, extrinsic allergic alveolitis, serum sickness) and TDTH-mediated (Type IV) hypersensitivity.
Unit V	Overview of Autoimmunity and Transplantation - Autoimmune disease – Spectrum –organ specific (thyroid diseases, IDDM, pernicious anemia) and non-organ specific (Systemic sclerosis & SLE). Factors governing autoimmune diseases- genetic, hormonal, microbial and non-microbial. Regulatory mechanisms involved in autoimmune diseases- Tolerance – breakdown of tolerance (Modification of auto antigen, Cross-reactions with B cell epitopes, molecular mimicry of T cell epitopes. Transplants –auto, allo and Xeno-immunological complications of transplantation – graft rejection, GVHD – mechanisms – prevention of graft rejection- Immunosuppressant Drugs (Glucocorticoids, Calcineurin inhibitors, Antiproliferative/Antimetabolic agents) and antibodies as immunosuppressant.
Current Contours	**(Not for Final Exam, only for Discussion)** Diverse factors influencing the functions of immune system and evolution of immune system in organisms.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	VS	VS	VS
CO3	VS	VS	S	M	VS
CO4	M	VS	VS	VS	S
CO5	VS	M	VS	S	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Janis Kuby. (2011). Immunology 6th edition.
2. Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Roitt. (2017). Roitt‟s Essential Immunology 13th Edition.
3. Abul K Abbas, Andrew H Lichtman and Shiv Pillai. (2021). Cellular and Molecular immunology 10th Edition.

Related Online Contents:

1. http://medicalppt.blogspot.in/2016/02/immunology-lecture-notes.html
2. https://immunologynotes.com/
3. https://www.cdc.gov/

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SEMESTER - V

CORE COURSE 7: PHARMACOLOGY AND TOXICOLOGY

Course Code	BM35C7	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on the field of pathophysiology								

Course Objectives:

- To strengthen the basic knowledge on the field of Pharmacology.
- To impart recent advances in the drugs used for the treatment of various diseases.
- To understand the concepts of drug action and mechanisms involved.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand what drugs do to the living organisms and how their effects can be applied to therapeutics?	K1, K2
CO2	• Understand the pharmacological actions of drugs in CNS, ANS and PNS	K2
CO3	• Understand mechanism of action of drugs involved in Gastrointestinal tract, Urinary system and Chemotherapy	K2
CO4	• Understand the pharmacological actions of drugs acting on Cardiovascular, Respiratory, and Endocrine system	K2
CO5	• Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases	K7
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	General Pharmacology: Introduction to Pharmacology, Sources of Drugs, Dosage forms, Routes of Drug administration, Pharmacokinetics (ADME), Pharmacodynamics- (Receptors-Classification of receptors), Combined effect of drugs, Factors modifying drug action,

Unit II	Neuropharmacology: Pharmacology of Central Nervous System: General anesthetics, sedatives, hypnotics, opioid Analgesics, Anti-Anxiety, Cognition enhancers. Pharmacology of drugs acting on ANS: Adrenergic and cholinergic drugs Pharmacology of Peripheral Nervous System: Local Anesthetics, Skeletal Muscle Relaxants, Anti-inflammatory drugs.
Unit III	Gastro-pharmacology, Renal pharmacology Chemotherapy: Pharmacology of Gastrointestinal tract system: Antacids, anti-ulcer drugs, Laxatives and Anti- diarrheal drugs, Emetics and anti-emetics. Pharmacology of Urinary System: Diuretics and Anti- diuretics. Chemotherapy: General principles of chemotherapy, Antibiotics – Penicillin, Chloramphenicol, Chemotherapy of malignancy.
Unit IV	Pharmacology of Cardiac Vascular System: Cardiac glycosides and drugs for heart failure, Anti- hypertensive drugs. Pharmacology of Respiratory system: Anti-asthmatic drugs including bronchodilators, Anti-tussives and expectorants. Pharmacology of Endocrine System: Insulin, oral hypoglycemic agents & glucagon.
Unit V	Toxicology: Principles of toxicology. Acute, sub acute and chronic toxicity, ICH Guidelines on Safety Studies, Reproductive Toxicology-Risk Assessment in Reproductive Toxicity, Mutagenicity- Mechanism of Mutagenesis, Carcinogenicity, Toxicokinetics. Abnormal action of drugs such as tolerance, addiction, habituation, idiosyncrasy, allergy, hypersensitivity, antagonism, synergism, potentiation, tachyphylaxis, adverse drug reactions
Current Contours	**(Not for Final Exam, only for Discussion)** Chronopharmacology: Biological and circadian rhythms, applications of chronotherapy in communicable and non-communicable diseases.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	VS	S	VS	VS
CO2	VS	S	S	VS	VS
CO3	VS	VS	S	M	VS
CO4	S	VS	VS	S	M
CO5	VS	VS	VS	S	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Tripathi, K.D. (2015). "Essentials of Medical Pharmacology", 7th Edition, Jaypee Brothers Medical Publishers (P) Ltd.
2. Satoskar, R.S., Bhandarkar, S.D. and Rege, N. (2015). "Pharmacology andPharmacotherapeutics", 24th edition, Popular Prakashan (P) Ltd.
3. H.L. Sharma, K.K. Sharma. (2017). Principles of Pharmacology, Paras Medical Publishers, 3rd Edition,
4. Christopher P Changelis, ShayneCox Gad, Joseph F Holson. (1995) Regulatory Toxicology, Second Edition, Publisher: Informa Healthcare
5. Laurence L. Brunton, Bjorn C. Knollmann,Randa Hilal-Dandan, Goodman and Gilman's, McGraw-Hill Education /Medical. (2022). The Pharmacological Basis of Therapeutics, 14th edition.
6. Humphrey P. Rang, Maureen M. Dale, James M. Ritter, Rod J. Flower, Graeme Henderson, (2015). Rang & Dale's Pharmacology- 8th edition, Churchill Livingstone.
7. Katzung, B.G, Trevor AJ. (2015). Basic and Clinical Pharmacology, McGraw-Hill Education, 13th Edition.
8. Kille JW. (2024). Regulatory toxicology. In A comprehensive guide to toxicology in nonclinical drug development (pp. 515-557). Academic Press.
9. Pugsley MK, Winters BR, Koshman YE, Authier S, Foley CM, Hayes ES, Curtis MJ. (2024). Innovative approaches to cardiovascular safety pharmacology assessment. Journal of Pharmacological and Toxicological Methods. Jun 28:107533.
10. Chawla PA, Ekser B. (2024). Looking at the Bright Future of Health Sciences Review. Health Sciences Review. Mar 20:100165.

Related Online Contents:

1. https://bmcpharmacoltoxicol.biomedcentral.com/

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SEMESTER - V

LABORATORY COURSE -5: MOLECULAR BIOLOGY

Course Code	BM35CP4	Course Type	Laboratory Course	L	T	P	C	Syllabus version	2022-2023
				1	-	3	3		
Pre-requisite	Knowledge on nucleic acids and proteins								

Course Objectives:

• To impart knowledge on the basic techniques such as genomic DNA and plasmid DNA isolation
• To gain hands on experience in gel-electrophoresis techniques.
• To develop & train students with the knowledge on PCR & blotting techniques.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Know the basic concept and principles of molecular biology techniques	K1
CO2	• Gain hands on experience in extraction of genomic & plasmid DNA	K1, K3
CO3	• Learn the basic methods of DNA quantification and purification	K4
CO4	• Gain the practical knowledge on agarose gel electrophoresis	K1, K4
CO5	• Perform the experimental procedure of PCR technique	K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Experiments	1. Extraction of plasmid DNA Extraction of genomic DNA. 2. Quantification of DNA- UV-Visible spectrophotometer and analysis of purity 3. Agarose gel electrophoresis 4. Restriction enzyme digestion 5. Isolation of DNA fragment from agarose gel 6. Polymerase Chain Reaction and analysis by agarose gel electrophoresis 7. Blotting Techniques (Southern, Northern & Western blot) (Demo)

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	S	VS	M
CO3	VS	VS	VS	S	VS
CO4	VS	S	M	VS	VS
CO5	VS	VS	VS	VS	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Laboratory Press, Pearson Publication.
2. Sambrook, Joseph and David W. Russell. (2006). "The Condensed Protocols: From Molecular Cloning: A Laboratory Manual" Cold Spring Harbor,
3. Saeed Siavashy, M. Soltani, Shayan Rahimi, Mehraveh Hosseinali, Zahra Guilandokht, Kaamran Raahemifar. (2024) Recent advancements in microfluidic-based biosensors for detection of genes and proteins: Applications and techniques, Biosensors and Bioelectronics: X, Volume 19, 100489, ISSN 2590-1370, https://doi.org/10.1016/j.biosx.2024.100489.

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SEMESTER - V

SKILL BASED ELECTIVE COURSE -1: BIOTECHNIQUES

Course Code	BM35S1BT	Course Type	Skill Based Elective	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on macromolecules in biological system								

Course Objectives:

- To study the fundamental principles and applications of various bio-analytical techniques.
- To learn techniques that is involved in characterization of protein and nucleic acid.
- To know methods for analyzing the structure and dynamics of biological macromolecules.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Apply centrifugation techniques in biological research and laboratory tests.	K1, K3
CO2	• Comprehend the biological processes at the molecular level using microscopic technique.	K4
CO3	• Quantify and study the activity of biomolecules using various spectrophotometry methods.	K7
CO4	• Characterize protein and nucleic acids by applying electrophoresis technique.	K2, K3
CO5	• Know the basic bioinstrumentation techniques that are applied in laboratory research.	K1, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	General principles of biochemical investigations. *In vivo* and *In vitro* models. Cell disruption methods, homogenates and subcellular fractionation. Centrifugation techniques: Basic principle of sedimentation, RPM, RCF and Svedberg unit. Centrifuges and their uses. Rotors and its types. Preparative and analytical centrifugation: Methods and applications of differential and density gradient centrifugation (rate zonal and isopycnic). Analytical ultracentrifugation: Technique and applications.
Unit II	Microscopy: Basic principle, instrumentation and applications of Light microscopy, Fluorescence microscopy, Phase contrast microscopy and Electron microscopy (TEM and SEM). Spectroscopic techniques: Principle of Colorimeter, Beer-Lambert's Law, instrumentation and applications of UV-Visible Spectrophotometry, Spectrofluorimetry and atomic absorption spectrometry.

Unit III	Electrophoresis: General principle, methods and applications. Factors affecting electrophoresis. Types of electrophoresis: Paper and Gel electrophoresis: Equipment and applications. Components of an electrophoresis unit, technique, staining and destaining procedure. Gel matrices: Agarose gel, Polyacrylamide gel electrophoresis (PAGE). Native gel and SDS-PAGE. 2D-Gel electrophoresis, Isoelectric focusing.
Unit IV	Chromatography: Basic principle and chromatography techniques. Partition or distribution coefficient. Types of chromatography - Column and thin Layer chromatography. Principle, technique and applications of paper, partition, adsorption, ion-exchange, gel exclusion and affinity, gas-liquid chromatography. High performance liquid chromatography and Fast protein liquid chromatography - Instrumentation and applications in biological system.
Unit V	Tracer techniques: Principles of radioactivity, nature and types. Radioisotopes and half-life. Units of radioactivity. Applications of radioactivity and radioisotopes in biological research and medical diagnosis. Detection and measurement of radioactivity. Radiation hazards and its measurements. Autoradiography, principle and applications of liquid scintillation counter and Geiger-Muller counter.
Current Contours	**(Not for Final Exam, only for Discussion)** Cell fractionation techniques, Methods for purification of proteins, Principles, instrumentation and applications of electron spin resonance, Nuclear magnetic resonance, X-Ray crystallography and Mass spectrometry.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	S	VS	M	VS
CO2	S	S	S	S	S
CO3	VS	M	VS	VS	S
CO4	S	VS	S	VS	M
CO5	VS	S	VS	M	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Wilson, K., & Walker, J. (2010). *Principles and Techniques of Biochemistry and Molecular Biology*, (7th ed.). Cambridge University Press, New Delhi, India.
2. David, S. (2009). *Physical Biochemistry: Principles and Applications*, (2nd ed.). John Wiley & Sons Ltd. UK.
3. Upadhyay, A., Upadhyay, K., & Nath, A. (2014). *Biophysical chemistry: Principles and Techniques*, (4th ed.). Himalaya Publishing House, India.
4. Arumugan, N., & Kumaresan, V. *Biotechniques*. Ghosal, S., & Srivastava, A. K. (2009). *Fundamentals of Bio Analytical Techniques and Instrumentation*. PHI Learning Pvt. Ltd. India.
5. Shourie, A., & Chapadgaonkar, S. S. (2015). *Bioanalytical Techniques*. The energy and Resources Institute, TERI Press, India.

Related Online Contents:

1. https://doi.org/10.1016/S0091-679X(07)84006-4.
2. https://doi.org/10.2144/000112823
3. https://doi.org/10.14744/nci.2016.32757
4. https://doi.org/10.4172/2167-7956.1000156

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SEMESTER - V

SKILL BASED ELECTIVE COURSE -1: BIOINFORMATICS

Course Code	BM35S1BI	Course Type	Skill Based Elective	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on computer science and macromolecules								

Course Objectives:

- To provides platform to work with important bioinformatics software
- To gain knowledge on the genomics and proteomics
- To impart advancement in chemistry and bioinformatics

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the computation analysis to the capture and applications of bioinformatics. It is an interdisciplinary field, which harnesses computer science, mathematics, physics and biology	K1, K2
CO2	• Describe the main tools of the bioinformatician and discuss how they are being used tointerpret biological databases.	K1, K3
CO3	• Comprehend the potential clinical applications of these data in drug discovery and development.	K2
CO4	• Perform analysis of genome sequence databases, particularly the analysis of the human genomeproject, is one of the main achievements of bioinformatics.	K2, K4
CO5	• Analyze the catalogue of the biological pathways and networks that are an important part of systems biology.	K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	**Basics of Bioinformatics:** Role of computers in biology (biocomputing) _ Origin and Overview of bioinformatics- Applicationof bioinformatics - National and International Bioinformatics Institutes and Industries - Research in bioinformatics – Job Opportunities of bioinformaticians – Define- Homologs, Orthologs, Paralogs and Xenologs - various OMES and OMICS.
Unit II	**Biological Databases:** Open access bibliographic resources and literature databases: PubMed, PMC and Public library of Sciences (PLoS) - Sequences Databases: GenBabk, DDBJ, EMBL, PIR and Swiss- Port- Pattern and Motif Searches: PROSITE, BLOCKS, PRINTS, PFAM- Structuren: PDB and NDB- Structural classification databases: SCOP,

	CATH- Metabolic pathways and enzymatic database: KEGG, MetaCyc, BRENDA.
Unit III	**Sequence Alignment**: Pairwise Sequence alignment – Local and alignments – Dotplot- Dynamic Programming methods – Scoring or Substitution matrices (PAM and BLOSUM)- Statistics of alignment score – Database searching – FASTA and BLAST searches- Multiple Sequence alignment – CLSTALW – TCOFFEE –Tools for Drug Discovery / Drug Design. PHYLOGENETIC ANALYSIS: Sequence – based taxonomy – From Multiple Alignment toPhylogeny – methods for Construction & representation of phylogenetic tree using MEGA software.
Unit IV	**Genomics and Proteomics:** Genome Database: GOLD –Gene finders: GLIMMER and GENSCAN –Genome projects: Human. Features of protein sequence and structure – Proteomics tools in Expasy Server- Protein secondary structure prediction: GOR and SOPMA – Tertiary structure prediction: Homology modeling –protein structure Visualization tools: RasMol Viewer, UCSF- CHIMERA.
Unit V	**Advancement of Bioinformatics:** Overview- Systems biology- *E. Coil*, Chemoinformatics-drug database: ZINC, PubChem, DRUGBANK- Protein engineering- CUPSAT, ITCHY and SCRATCHY.
Current Contours	**(Not for Final Exam, only for Discussion)** Recent advances in system application of Protein sequencing and Data bases.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	VS
CO2	VS	VS	S	VS	S
CO3	S	VS	VS	S	VS
CO4	VS	S	S	VS	M
CO5	VS	VS	S	M	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Arthur M. Lesk. (2003). Introduction to Bioinformatics, Oxford University press, New Delhi.
2. Baxevanis and B.F. Ouellete. (2005). Bioinformatics: A practical Guide to the Analysis of genes andproteins, 3rd edition, Wiley – Interscience (Wiley Student Edition),
3. D. Higgins and W. taylor (Eds). (2000). Bioinformatics- Sequence, Structure and

Databanks, Oxford University press, New Delhi,
4. A.M. Campbell & L.G. Heyer. (2003). Discovering Genomics, Proteomics & Bioinformatics, Pearson Education, New Delhi.
5. S. R Pennington & M. J. Dunn. (2020). Proteomics– from Protein sequence to function, Viva Books Pvt. Ltd, New Delhi,
6. F.C. Boogerd, F.J. Bruggeman, J.-H.S. Hofmeyr and H.V. Westerhoff. (2007). Towards philosophicalfoundations of Systems Biology: introduction. Elsevier B.V. Isbn: 978-0- 444-52085-2.
7. Teresa Attwood and David Parry-Smith. (1999). Introduction to Bioinformatics. PearsonEducation. ISBN: 0582327881.
8. Vijai Singh, Ajay Kumar. (2024). Advances in Bioinformatics, 2nd Edition, ISBN-10: 9819984009, ISBN-13: 978-9819984008, Springer Verlag Publication.

Related Online Contents:

1. https://massivebioinformatics.com/2024/03/15/the-10-most-important-bioinformatics-breakthroughs-of-the-past-year/
2. https://omicstutorials.com/bioinformatics-in-2024-anticipated-trends-and-challenges/#google_vignette
3. https://www.bio-itworldexpo.com/24/bioinformatics
4. https://novapublishers.com/shop/advances-in-bioinformatics-and-big-data-analytics/
5. https://www.bioinformatics.org/

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SEMESTER - V

COURSE: SOFT SKILLS

Course Code	BM35SK	Course Type	Soft Skills	L	T	P	C	Syllabus version	2022-2023
				1	1	-	2		
Pre-requisite	Basic knowledge on communication and a good understanding								

Course Objectives:

- To Understand the Concept of Soft Skills: Introduce students to the definition, significance, process, and measurement of soft skills development.
- To Facilitate Self-Discovery: Help students in discovering their own strengths, setting personal goals, and understanding the impact of beliefs, values, attitudes, and virtues.
- To Enhance Communication Skills: Develop an understanding of different communication types (verbal and written), and improve awareness of non-verbal communication, such as body language and signs.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Knowledge of Soft Skills: Students will have a thorough understanding of soft skills and their importance in personal and professional life.	K1, K2
CO2	• Improved Self-Awareness: Students will be able to assess their personal traits, set goals, and align their beliefs and values for self-improvement.	K2
CO3	• Effective Communication: Students will be proficient in both written and verbal communication, as well as non-verbal cues such as body language, to ensure clear and confident interactions.	K3
CO4	• Personality Growth and Success Management: Students will develop an enhanced personality, learn how to overcome challenges, and identify key factors contributing to success and failure.	K2, K3
CO5	• Better Job Readiness: Students will be prepared for job opportunities by mastering resume building, group discussions, and interview techniques, including psychometric analysis.	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Soft Skills: An Introduction – Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development.
Unit II	Self-Discovery: Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue.
Unit III	Introduction, Need for Communication, Process of Communication Types of Communication- Written and Verbal Communication, , Signs, Signals and Symbols, Body language
Unit IV	Introduction to Personality Development The concept of personality - Dimensions of personality - Significance of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure. SWOT analysis. Character building -Team-work – Time management.
Unit V	Employability Quotient Resume building- The art of participating in Group Discussion – Facing the Personal (HR & Technical) Interview -Frequently Asked Questions - Psychometric Analysis - Mock Interview Sessions.

Recommended References:

1. Hurlock, E.B (2006). Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill.
2. Stephen P. Robbins and Timothy A. Judge (2014), Organizational Behavior 16th Edition: Prentice Hall.
3. Andrews, Sudhir. How to Succeed at Interviews. 21st (rep.) New Delhi. Tata McGraw-Hill 1988.
4. Heller, Robert. Effective leadership. Essential Manager series. Dk Publishing, 2002
5. Hindle, Tim. Reducing Stress. Essential Manager series. Dk Publishing, 2003
6. Lucas, Stephen. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill. 2001
7. Mile, D.J Power of positive thinking. Delhi. Rohan Book Company, (2004).
8. Pravesh Kumar. All about Self- Motivation. New Delhi. Goodwill Publishing House. 2005.
9. Smith, B. Body Language. Delhi: Rohan Book Company. 2004

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SEMESTER - V

COURSE: GENDER STUDIES

Course Code	BM35GS	Course Type	GENDER STUDIES	L	T	P	C	Syllabus version	2022-2023
				1	1	-	2		
Pre-requisite	Gender Studies is a field that focuses on the socio cultural, political, and ideological dimensions of sexual categorization and sexual relations. It also examines the complex inter-relationships of gender with other societal structures, such as class, caste, race, and religion.								

Course Objectives:

- Gender studies analyze and critique social and cultural systems of power that create and reinforce hierarchies of difference.
- Gender studies are an interdisciplinary academic field devoted to analyzing gender identity and gendered representations.
- Gender analysis offers information to understand women's and men's access to and control over resources that can be used to address disparities, challenge systemic inequalities (most often faced by women), and build efficient and equitable solutions

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand sex and gender as social construct that are intersectional and vary across time, space and culture.	K1, K2
CO2	• Cultivate interest in societal concerns related to sex, gender and inequality.	K2
CO3	• Students can develop the ability to think critically and analytically	K2, K4
CO4	• Students can learn about gender discrimination and gender justice, and how to spread awareness about these issues.	K2
CO5	• Students can learn about gender perspectives in health, and how to analyze the relationship between power, violence, and patriarchy.	K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	**Gender and Feminist perspective**: Gender as a Social component. Gender meaning- Feminism – meaning, radical feminism, Liberal Feminism, Multicultural feminism, Marxist Feminism, Socialist Feminism, Emerging concept of Eco-Feminism, Psychological Feminism. Models of Gendered Socialization. **Theories of Gender Relations:** Liberalist, Radical, Socialist and Post-Modernist.
Unit II	**Gender in Indian Society**: Socialization and Gender roles, Discrimination and Girl child, Motherhood, Female headed Household, Single Parenthood, Household Work and invisible work, Values reinforcing Women's subordination.
Unit III	**The Changing Profile of Women in India:** Changing position of women in India, pre-colonial, colonial and post-Independence period. ICT Policy for women in India- Objectives and programmes.

Unit IV	**Women and work**: Women managers and their problems, Women entrepreneur, women in unorganized sector, and their problems.
Unit V	**Issues affecting the quality of life of women: -** Health education and property rights, Gender based violence, early marriage, personal laws, Hindu code Bill, Christian laws and Muslim personal laws. Social structure and Gender Inequality, Patriarchy and Matriarchy, Division of Labour.
(Current contours)	**(Not for Final Exam, only for Discussion)** Gender research offers updated empirical knowledge about gendered practices, norms, and discourses in significant ways.

Recommended References:

1. Anitasrivastav, Women in India, problems and prospects, Indian publishers Distributors, Delhi 2004.
2. Singh. B.K. women empowerment, adhyayan publishers & Distributors. Delhi 2006.
3. Kirit K. shah and Radhika seshan, Visibilising women, Kalpz publications, 2005
4. Tandon R.K. State of Women in India, Indian Publishers, Distributors, 1998.
5. T.M.Dak, Women and Work in Indian Society, Discovery Publishing House, Delhi, 1988.
6. R.B.Mishra, Chandra Pal Singh, Indian Women – Challenges and Challenges, Ajay Verma for Commonwealth publishers, 1992.
7. Krishna raj, Maithreyi, Women's studies in India, Bombay Popular Prakashan, 1986.
8. Gelles ann Levine, Sociology an introduction.
9. Harlambas, Sociology: Themes and Perspectives, Oxford University Press, 1980.
10. Singh Kamla. Women entrepreneurs, Ashish publishing House, New delhi, 1992.
11. Chaurasia B.P., Women's status in India, Chugh publications, Allahabad-India, 1992.
12. Raj Kumar Pruthi, Rameshwari Devi, Ramila Pruthi – Status and Position of Women In Ancient Modern India, Mangal deep publications, Jaipur, 2001.

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SEMESTER – VI

CORE COURSE -8: BIOTECHNOLOGY

Course Code	BM36C8	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on advanced biology								

Course Objectives:

- To facilitate the students to know the basics of biotechnology
- To understand the needs of biotechnology for human welfare
- To understand the needs of biotechnology for well- being of the health and society

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the basics of biotechnology and its applications for the welfare of human.	K1, K2
CO2	• Comprehend its application in creating animal models for human genetic disorder and development of transgenic plants and animals for human welfare.	K6
CO3	• Describe its application in the field of agriculture like improvement of crop yield etc.	K5
CO4	• Illustrate its application in the control of environmental pollution	K5
CO5	• Know the applications of Nanobiotechnology for the development of drug delivery systems and its applications in production of recombinant proteins and vaccines	K1, K2, K6
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Biology of vectors - Salient features of cloning vectors- Types of cloning vectors: plasmids, cosmids, single stranded M 13, Phagemids, Shuttle vectors, Broad Host range Vectors. Viral vectors. Eg. SV40, adenovirus, retrovirus, vaccinia virus vectors and its applications. Baculovirus vectors and its use for biocontrol. Binary vectors, Gateway vectors and RNAi vectors.
Unit II	Advances in Animal Biotechnology - Scope of Animal Biotechnology, Knockout mice and mice model for human genetic disorder; CRISPR-Gene editing technology, transgenesis- methods of transferring genes into animal oocytes, eggs, embryos and specific tissues by physical, chemical and biological methods; Transgenic animals (Mice, Cows, Pigs, Sheep, Goat, Birds and Insects);
Unit III	Environmental and Microbial Biotechnology - Biodegradation, Microbiology of degradation and its mechanism, metabolic pathways for Biodegradation for specific organic pollutants, Bioaugmentation, Biosorption, Bioleaching, Bioremediation- Types of Bioremediation.

Unit IV	Nanobiotechnology & Pharmaceutical Biotechnology - Overview of Nanobiotechnology and Nanoscale processes; Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation to nanomaterials. Properties of nanocarriers; drug delivery systems used in nanomedicine; Health and environmental impacts of nanotechnology. CASE STUDIES ON Biopharmaceutical Product Development - Erythropoietin, Insulin, Somatotropin, Interleukin-2, Interferon Granulocyte-macrophage-CSF, Factor VIIa, Factor IX, Factor VIII, Tissue plasminogen activator, Monoclonal antibodies and engineered Mab.
Unit V	Plant Biotechnology -Features of a plant transformation vectors, Constitutive, inducible and tissue specific promoters, terminators and regulatory elements; Selectable markers and reporter genes; Modification of heterologous gene (animals, microbes) for plant transformation. Agrobacterium mediated and direct gene transfer methods. Bt crops, Golden Rice, Transgenic systems to derive carbohydrates, plantibodies, edible vaccines, enzymes, biopharmaceuticals, and functional protein processing steps in plants.
Current Contours	**(Not for Final Exam, only for Discussion)** Understand the role of biotechnology in food processing and forensic medicine.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	S	S	M
CO3	VS	VS	VS	VS	VS
CO4	S	VS	S	M	VS
CO5	VS	S	VS	VS	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Paul Prave, Uwe Faust, Wolfgang. (2004). Fundamentals of Biotechnology VCH publishing.
2. Ignacimuthu, S. (1996). Applied Plant Biotechnology, Tata McGrawhill.
3. Purohit, S.S. (2003). Agricultural Biotechnology. Agrobios India.
4. A.Slater, N.Scott and M.Flower. (2003). Plant Molecular Biology and Biotechnology, Oxford University Press, Oxford.
5. Gene Cloning – Glover. (1984). oxford University press.
6. Ernst Winnacker panima. (2003). From genes to clones. Publishing corporation, India.
7. Old and Primrose. (2001). Principles of gene manipulation 6th Ed, Black well scientific publications, London.
8. Goodman & Gilman's. (2006). The Pharmacological Basis of Therapeutics,11th edition, Mc Graw-Hill Medical Publishing Division New York,
9. Sarfaraz K. Niazi. (2006). Handbook of Biogeneric Therapeutic Proteins: Regulatory, Manufacturing, Testing, and Patent Issues, CRC Press.
10. Rodney J Y Ho, MILO Gibaldi. (2003). Biotechnology & Biopharmaceuticals Transforming proteins and genes into drugs, 1st Edition, Wiley Liss.
11. Francis, D., Chacko, A.M., Anoop, A., Nadimuthu, S. and Venugopal V. (2024). Evolution of biosynthetic human insulin and its analogues for diabetes management.
12. Chandrakant Prof Kokare (Author). (2019). Pharmaceutical Biotechnology.

Related Online Contents:

1. Sooram Banesh, Surajbhan Sevda, Biotechnology advances in disease treatment, Reference Module in Biomedical Sciences, Elsevier, 2024, ISBN 9780128012383, https://doi.org/10.1016/B978-0-323-99967-0.00234-9.

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SEMESTER - VI

CORE COURSE -9: CLINICAL MICROBIOLOGY

Course Code	BM36C9	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on microbiology								

Course Objectives:

- To acquire depth knowledge on medically important bacteria.
- To gain information about the bacterial infection occurs in Digestive, Reproductive, Respiratory and Nervous system.
- To get information about the fungi and pathogenesis of Parasitology.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the basic knowledge on medically important bacteria.	K1, K2
CO2	• Get a clear idea on enterobacetriaceae family and its pathogenicity in Digestive system.	K5
CO3	• Understand the pathogenicity and diagnosis of the microbes in nervous system.	K2, K7
CO4	• Gain knowledge on viral diseases.	K7
CO5	• Acquire information on mycology, mycotoxins and medically important yeasts.	K5
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	General: General properties of medically important bacteria. Recommendation for collection, transport of specimens, Isolation of bacteria from clinical specimens- Primary media for isolation and their quality control – Antibiotic sensitivity disc, testing procedure and their quality control.
Unit II	Bacteriology Digestive system – *Escherichia coli, Salmonella, Shigella* and *Vibrio*.Urinary system – *Leptospira sp.*, and *proteus Respiratory system – Mycobacterium tuberculosis*

Unit III	Bacteriology Reproductive system – *Neisseria* and *Treponema*, Nervous system – *Clostridium tetani*
Unit IV	Virology: General properties of viruses – Detection of viruses and antigens in clinical specimens – Serological diagnosis of virus infections. Hepatitis, Pox, Oncogenic and Human Immuno Deficiency (HIV) viruses. Viral vaccines – their preparation and Immunization schedules.
Unit V	Mycology and Parasitology: Introduction to medical mycology – morphology of fungi. Detection and recovery of fungi from clinical speciemens. Yeast of medically importance – *Candida* and *Cryptococcus*. Introduction to Medical parasitology – Protozoan – *Entamoeba* – *Plasmodium*, *Trypanosoma*. Laboratory techniques in parasitology- Examination of faeces for ova and cysts – Concentration methods.
Current Contours	**(Not for Final Exam, only for Discussion)** Disease Control: Awareness-Prevention-Treatment-Role played by NGOs and Health officials. Recommendation Prescribed-World Health Organization-Center for Disease Control-Indian Council for Medical Research.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	VS
CO2	VS	VS	VS	VS	M
CO3	VS	VS	VS	S	S
CO4	S	S	M	VS	S
CO5	VS	S	S	S	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Prescott, L.M., J.P. Harley and D.A. Klein. (1993). Microbiology. 2nd Edition. W.M.C Brown Publishers.
2. David Greenwood, Richard B Slack and John F. (2021). Medical Microbiology. Peutherer. Chirchill Livingstone (London) 16th Edition.
3. Jawetz., E. J.L. Melnic and E.A. Adelberg. (2000). Review of Medical Microbiology. 19th edition. Lange medical publications. U.S.A.
4. Ananthanarayan R. and C.K. Jeyaram Panikar. (1994). Text book of Microbiology. Orient Longman.
5. Timbury M.C. (1986). Medical Virology, 9th Edn., Churchill Livingston London.
6. Jagadish Chandar. (1996). A Text book of Medical Mycology. Interprint. New Delhi.
7. Subhash Chandra Parijia. (2005). Text book of Medical parasitology (Protozoology & Helminthology). 2nd Edition, Medical books publishers, New Delhi.
8. Apurba S Sastry, Sandhya Bhat. (2023). Essentials of Medical Microbiology, 4th Edition, ISBN-10: 9356963320, ISBN-13: 978-9356963320, Jaypee Brothers Medical Publishers.
9. Michael A. Pfaller, Karen C. Carroll. (2023). Manual of Clinical Microbiology, 4 Volume Set, 13th Edition, ISBN: 978-1-683-67429-0.
10. Ananthanarayan and Paniker's. (2023). Text book of Microbiology, 12th Edition.

Universities Press Private Ltd., ISBN: 978-93-93330-01-7.
11. Subhash Chandra Parija. (2024). Textbook of Microbiology and Immunology, 4th Edition. ISBN: 9789819992614, Springer Verlag Publishers.

Related Online Contents:

1. https://journals.asm.org/doi/full/10.1128/cmr.00002-14
2. https://journals.asm.org/journal/jcm
3. https://www.microbiologyresearch.org/content/journal/jmm
4. https://journals.lww.com/aidsonline/fulltext/2004/01230/Initiating_co_trimoxazole_prophylaxis_in.00015.aspx
5. https://www.nature.com/subjects/clinical-microbiology

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SEMESTER - VI

CORE COURSE -10: HUMAN PATHOLOGY

Course Code	BM36C10	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on human anatomy and physiology								

Course Objectives:

- To provide a comprehensive knowledge on system pathology emphasizing on cellular changes under various disease conditions.
- To study the diagnostic molecular pathology techniques and its clinical applications.
- To describe the various staining practices with significance in pathology.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the etiology and pathogenesis of wide human diseases.	K2
CO2	• Explain the molecular basis of disease and describe pathological changes effectively.	K1
CO3	• Gain knowledge on basic tissue processing methods for molecular diagnosis.	K1
CO4	• Examine the organization of tissues, cells and molecules by histological studies.	K1, K2
CO5	• Analyse the morphological properties of abnormalities in tissues and cells.	K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	General Pathology: Etiology and Pathogenesis of cell injury, Mechanism of cell injury and morphological changes during cell injury, Cellular adaptations, Intracellular accumulations, Extracellular deposits (Amyloidosis), Circulatory disturbances of blood: Thrombosis, embolism, ischaemia and infarction (Definition and effects only). Inflammation: Definition, types (Acute and Chronic) and general features, Healing and Repair (Wound healing). Disorders of growth, Neoplasia: Definition, classification and microscopic features. Grading and staging of cancer.
Unit II	Systemic Pathology I (Pathological process and Histological features only): Haematopoietic system (Anemia), Lymphoid system (Leukemia), Cardiovascular system (Myocardial infarction), Respiratory system

	(Pulmonary tuberculosis), Alimentary tract (Gastritis), Hepatobiliary system (Hepatitis & Cirrhosis), Pancreas (Pancreatitis) and Urinary system (Glomerulonephritis).
Unit III	Systemic Pathology II (Pathological process and Histological features only): Male and Female reproductive system (Endometrial hyperplasia, Carcinoma of prostate), Endocrine system (Pituitary adenoma, Hashimoto‟s thyroiditis), Skin (Dermatitis), Skeletal system (Osteomyelitis) and Nervous system (Meningitis & Glioma).
Unit IV	Histopathology techniques and Routine staining: Pathologic examination of tissues–Paraffin- embedded sections. Tissue resection, Fixation and Fixatives, Dehydration, Embedding and Sectioning (Microtome), Mounting, Clearing and Staining. Cryo sections in histopathological examination. Routine staining methods - Hematoxylin and Eosin (H & E) staining, Gram‟s staining and Romanowsky staining (Hematology). Dyes and its classification, Mordant, Types of staining methods [Vital, routine (H & E) and special staining], Regressive & Progressive methods
Unit V	Special Stains (Histochemistry): Decalcification and staining of bone. Staining of organisms: Simple staining and differential staining (Gram staining, Giemsa and Acid fast staining), identification of Fungi (Lactophenil cotton blue staining). Special stains (Stains for the detection of connective tissue, collagen, carbohydrates & minerals - Periodic Acid Schiff, Silver stain, Trichrome staining).
Current Contours	**(Not for Final Exam, only for Discussion)** Molecular pathology of cancer, microscopic examination of tissue biopsy samples and diagnosis oftumors. The challenges in pathological screening and the essential training in pathology. Digital imaging systems and advancement in technology in the clinical laboratory lines.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	S
CO2	VS	S	S	VS	VS
CO3	VS	VS	VS	VS	VS
CO4	VS	VS	M	VS	M
CO5	S	M	VS	S	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Vinay Kumar, Abbas, A. K., & Aster, J. C. (2017). Robbins Basic Pathology. 10th Edn. Publisher: Elsevier Publications, Canada.
2. Harsh Mohan. (2015). Textbook of Pathology. 7th Edn. Publisher: Jaypee Brothers Medical Publishers (P) Ltd., New Delhi, India.
3. Young, B., Stewart, W., & O'Dowd. G. (2009). Wheater's Basic Pathology: A Text, Atlas and Review of Histopathology. 5th Edn. Publisher: Elsevier Health Sciences, Churchill Livingstone Publications, UK.
4. Travis, G., Brown, W. L., Kemp, Dennis, K., & Burns. (2008). Pathology: The Big Picture. 1st Edn. Publisher: McGraw-Hill Companies.
5. Stevens, A., James, S., Lowe, & Barbara, Y. (2002). Wheater‟s Basic Histopathology. 4th Edn. Publisher: Elsevier Health Sciences, Churchill Livingstone Publications, UK.

Related Online Contents:

1. https://www.sciencedirect.com/journal/human-pathology
2. https://www.sciencedirect.com/journal/human-pathology-reports
3. https://preston.libguides.com/c.php?g=223885&p=1483903
4. https://libguides.alfaisal.edu/pathology/web/resources

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SEMESTER – VI

LABORATORY COURSE -6: CLINICAL PATHOLOGY

Course Code	BM36CP5	Course Type	Laboratory Course	L	T	P	C	Syllabus version	2022-2023
				1	-	3	3		
Pre-requisite	Knowledge on pathology and microscopy								

Course Objectives:

- To provide hands on training on basic Histopathology techniques.
- To troubleshoot the specimen preparation and staining.
- To equip students for analysing the bio-samples and to interpret the results.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Handle Instruments related to clinical pathology	K3
CO2	• Handle biological specimens	K3
CO3	• Process the biological samples	K4
CO4	• Prepare tissue sections using biopsy sample.	K2, K3
CO5	• Prepare and stain the smears.	K2, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Experiments	1. Instruments used in histopathology techniques: Microtome, water bath and hot air oven(Structural observation and standard operating procedure) 2. Chemicals used for histopathology techniques: properties and principles of staining chemicals(Heamatoxylin and Eosin). 3. General chemicals used for histology (Ethanol, xylene, paraffin wax, chloroform) 4. Different types of fixatives and clearing agents used in histopathology (preparation andcomposition) 5. Tissue processing and staining (H&E). 6. Observation and analysis of various diseased tissues (Microscopic observation)

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	S	VS	VS	S
CO3	VS	VS	VS	M	VS
CO4	VS	VS	S	VS	M
CO5	S	VS	VS	S	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Sabitri Sanyal. (2012). Clinical Pathology: A Practical Manual, 3rd Edition, Elsevier Health Sciences
2. Provan, D. ed. (2018). Oxford Handbook of clinical and laboratory investigation. 2nd Edition, Oxford University Press.

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SEMESTER - VI

SKILL BASED ELECTIVE COURSE -2: MEDICAL LABORATORY TECHNIQUES

Course Code	BM36S2ML	Course Type	Skill Based Elective	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on biochemistry, human physiology, pathology and microbiology								

Course Objectives:

• To educate and train a person to a skilled level of expertise in the domain area of the growing Health Sector.
• To enable the students to acquire knowledge on pathological laboratory and operation of ground based growing health industry needs.
• To educate and train a person to a skilled level of expertise in the domain area of the growing Health Sector.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Perform routine clinical laboratory procedures within acceptable quality control parameters in Hematology, Chemistry, Immunohematology, and Microbiology under the general supervision of a Clinical Laboratory	K1, K2
CO2	• Demonstrate technical skills, social behavior, and professional awareness incumbent upon a laboratory technician	K2, K3
CO3	• Apply systematized problem solving techniques to identify and correct procedural errors, identify instrument malfunctions and seek proper supervisory assistance, and verify the accuracy of laboratory results obtained.	K4
CO4	• Operate and maintain laboratory equipment, utilizing appropriate quality control and safety procedures.	K2
CO5	• Recognize and participate in activities which will provide current knowledge and upgrading of skills in laboratory medicine or health science.	K1, K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	General over view: Health and disease- Classification of medical Laboratories-Organization, Structure and role of medical laboratory service- Laboratory policies- Laboratory recording- Maintenance of Stock Registers- Consumables & Non-consumables - Code of Ethics of a laboratory Professional - Accreditation and Certification of Laboratories- Accrediting Agencies- NABL, ISO, CAP, CRISIL - Bar coding and Total Laboratory Automation (TLA)- Familiarization of Common Laboratory Software
Unit II	Laboratory instruments & Diagnostic tools: Balances, Centrifuges, Refrigerators, Ovens, Water bath, Incubators, Colorimeter (photometer), Desiccators, pH meter, Microscope, Distillation apparatus, Deionizer & Types of Auto Analyzers-Semi and Fully Automated Electrolyte Analyzer, Histotechnology-Microtomes & Rotary Microtome, ELISA, Immuno-Fluorescence & Immunochromatographic technique – Advanced diagnosis methods- C.L.I.A., C.L.F.A, Turbidometry, Nephelometry, HPLC, Mention Point of care testing (POCT)
Unit III	Laboratory safety: Signs and symbols used in a laboratory, Laboratory Hazards-Physical, Chemical, Biological, Electrical, Fire, Radiation Laboratory Safety Precautions, Firs aid practice for laboratory hazards, Handling and storage of chemicals and reagents, Personal Hygiene - Importance & methods of sterilization and Disinfection- Biomedical Waste Management
Unit IV	Importance, Common specimens, General guidelines for sample collection - Processing and transportation of common specimens-Urine, Blood, Sputum, CSF, Stool, Pus, body fluids, swabs - Basic identification Techniques of Bacteria- Growth &Cultivation of Bacteria -Blood transfusion,
Unit V	Microbiology: Classification of Microbes, pathogen, commensals, type of Infections, communicable diseases, Diagnostic techniques for viral infections - Common viral diseases and pathogens encountered - AIDS, Hepatitis, Dengue, Chikungunya, Rabies, Influenza, Mumps and Measles -Immunology and its diagnostic applications: Types of Immunity, Antigen ,Antibody - Structure of antibody Types of antibody- Ig G, IgM, IgA, IgD, Ig E • Antigen Antibody reactions- Specificity, Sensitivity, Avidity, Pro-zone ,post-zone, Titre Clinical applications of Agglutination, precipitation.
Current Contours	**(Not for Final Exam, only for Discussion)** Artificial Intelligence (AI) and Machine Learning (ML) in Diagnostics: AI in Medical Imaging and Pathology: Implementation of AI algorithms for enhanced imaging and histopathology analysis, enabling faster and more accurate diagnostics. Machine Learning for Predictive Diagnostics: Use of ML models to predict disease outcomes, patient risk profiles, and early detection of complex diseases. Natural Language Processing (NLP) in Healthcare: Leveraging NLP in electronic health records and lab reports to extract relevant clinical information for improved decision-making.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	M	S	VS
CO3	VS	VS	VS	M	VS
CO4	VS	S	VS	VS	VS
CO5	VS	S	VS	VS	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. G.R. Jones. (2024). Accreditation: Toxicology Laboratories, Reference Module in Social Sciences, Elsevier, ISBN 9780443157851, https://doi.org/10.1016/B978-0-443-21441-7.00001-7.
2. Meurig T Gallagher, Emily Roxburgh, Gwen Bennett, Susan Parker, Jackson C Kirkman-Brown, Laboratory Diagnostic Andrology UK Guidelines for Good Practice. (2024). Reproductive Bio Medicine Online, 104373, ISSN 1472-6483, https://doi.org/10.1016/j.rbmo.2024.104373.

Related Online Contents:

1. https://www.who.int/ihr/publications/lqms/en/
2. https://www.nabl-india.org/
3. https://www.cdc.gov/labtraining/lab-safety.html
4. https://www.aacc.org/science-and-research/point-of-care-testing
5. https://microbiologysociety.org/why-microbiology-matters/clinical-and-diagnostic-microbiology.html

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SEMESTER - VI

SKILL BASED ELECTIVE COURSE -2: FORENSIC SCIENCES

Course Code	BM36S2FS	Course Type	Skill Based Elective	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on genetics, chemistry, molecular biology and human biology								

Course Objectives:

- To introduce the students to know the importance of forensic science in crime scene investigation.
- To educate the students to collect, preserve and process the crime scene evidences.
- To learn the forensic techniques and its applications.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the History of Forensic science and its significant role in judicial system	K2
CO2	• Understand some of the basic facts, concepts and principles relating to the physical and morphological identification	K1, K2
CO3	• Describe the principles and significance of crime scene protection and investigation.	K4
CO4	• Demonstrate the procedure of superimposition	K3
CO5	• Understand the role of crime scene reconstruction in crime investigation	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Forensic Science: Definition, History and Development-Identification: Age (From physical morphological features, Dentation, Estimation of age from bones), Determination of sex from bones-Forensic importance of hair-Forensic Science Laboratories - DFSS, SFSL, CFSLs, NCRB & NICFS

Unit II	Crime Scene examination: Documentation of crime scene - Recognition, Collection, Preservation of physical& trace evidences - Types of crime scene search- Crime Scene Photography- Superimposition- Lie detection (Polygraphy)- Track marks and Bite marks- Tachographs- Cyber Forensics.
Unit III	Finger prints: Classification, Preservation, Development, Lifting and Comparison, Automated Fingerprint Identification System (AFIS), Importance of finger prints-Lip prints (Cheiloscopy), iris and retina- Examination of biological fluids: Blood, Seminal and Saliva- Sexual offences and its medicolegal importance, Disputed Paternity & Maternity.
Unit IV	Cause and Mechanism of Death: Unnatural deaths, Thermal and electrical exposure, Asphyxial deaths, Infanticide, Criminal assaults, Poisoning, Vehicular accidents -Changes after Death: Immediate changes, Early changes, Late changes. Autopsy: Aims and objectives of conducting autopsy- Artefacts
Unit V	Forensic Toxicology: Introduction, Narcotic drugs - Alcoholic beverages, Licit and illicit liquors, Classification of poisons: corrosive poisons: Sulphuric acid, HCL, Carbolic acid, Oxalic acid -Metallic poisons: Lead, Arsenic, Mercury- Irritant poisons: Organic Irritants, Snake venom, Inorganic irritants (Phosphorus, Chlorine, Bromine), Mechanical irritants (powdered glass)-Food poisoning-Dope tests.
Current Contours	**(Not for Final Exam, only for Discussion)** Concept of brain death and its relevance.- Medico – legal aspects of: Potency and impotency, Legitimacy and Paternity , Virginity, Pregnancy and Abortion- Battered Baby Syndrome- Sexual exploitation of girl children – age and criminal responsibility – Relevant sections or pares in Indian Penal Code- Drugs and psychotropic substances.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	VS
CO2	VS	S	VS	VS	S
CO3	VS	VS	S	VS	VS
CO4	VS	VS	VS	M	S
CO5	VS	S	M	VS	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. P. C. Dikshit. (2013). Text book of Forensic Medicine and Toxicology- PEEPEE Publishers
2. V.V. Pillay. (2023). Text book of Forensic Medicine and Toxicology- Paras medical Publishers
3. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's. (2013) Techniques of Crime Scene Investigation, CRC Press, Boca Raton.
4. Lee and Gaensleen's. (2013) Advances in Fingerprint Technology, 3rd Edition, R.S. Ramotowski (Ed.), CRC Press, Boca Raton.
5. Rattan Lal and Dhiraj Lal. (2019). The Indian Penal code. 28th edition.
6. Saurabh Shukla, Sakshum Khanna, Tahir Ul Gani Mir, Jyoti Dalal, Deeksha Sankhyan, Kushagra Khanna. (2024). Emerging global trends and development in forensic toxicology: A review, Journal of Forensic and Legal Medicine, Volume 103, 102675, ISSN 1752-928X, https://doi.org/10.1016/j.jflm.2024.102675.

Related Online Contents:

1. https://nicfs.gov.in/nicfs/
2. https://ncrb.gov.in/en

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SEMESTER - VII

CORE COURSE -11: CLINICAL BIOCHEMISTRY

Course Code	BM47C11	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				5	1	-	5		
Pre-requisite	Fundamental knowledge on human physiology and biochemistry.								

Course Objectives:

- To learn the normal constituents of blood, urine and their importance in clinical diagnosis.
- To study liver, renal and gastric functional tests and their relationship with various diseases.
- To understand the role of enzyme measurements in diagnosis of various diseases.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend the changes in blood and its components in health and disease conditions.	K4, K7
CO2	• Gain knowledge on liver function tests and its clinical significance.	K2
CO3	• Apply renal and gastric functions and their changes in acute and chronic diseases.	K2
CO4	• Describe the changes in serum enzyme levels and hormones under various clinical conditions.	K2, K4
CO5	• Explain the causes, clinical signs and symptoms, diagnostic tests and treatment of metabolic syndromes.	K1, K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Specimen collection and processing (Blood, Urine, Stool etc.). Anti-coagulants and urine preservatives. Composition of blood, cells (formed elements), plasma proteins, lipoproteins and their functions. Anemia-Definition, pathophysiology and types. Iron deficiency, Megaloblastic, Pernicious and Hemolytic anemia. Hemoglobinopathies: Thalassemia and Sickle cell anemia.
Unit II	Liver Function Tests: Functions of liver. Test to assess the functions of the liver and its clinical importance. Routine laboratory tests (serum assays) for the diagnosis of various liver ailments. Jaundice disease: Types, symptoms, causes and diagnosis. Test for bilirubin, bile salts and bile pigments in blood and urine. Hepatic cholestasis, cirrhosis, fatty liver and gallstones.

Unit III	Renal Function Tests: Clearance tests - Inulin, Creatinine and Urea clearance test. Concentration and dilution tests. Phenol red (PSP) test. Urine analysis - Composition of urine, Chemical examination and tests for the detection of abnormal constituents. Gastric Functional Tests: Gastric secretions and composition. Examination of duodenal contents. Fractional (FTM) gastric analysis and its importance. Hypo and hyper acidity. Steatorrhea.
Unit IV	Clinical enzymology: Enzyme patterns in acute pancreatitis, liver diseases, bone disorders, myocardial infraction and muscle wasting. Clinically important enzymes: AST, ALT, LDH, creatine kinase, alkaline phosphatase and isoezymes and their changes. Endocrine system disorders: Introduction to human endocrine system. Hypo and hyper-secretion of hormones. Pituitary, thyroid, adrenal and gonadal function tests.
Unit V	Metabolic disorders: Carbohydrate metabolism: Diabetes mellitus, types, clinical features, diabetic complications and its management. Diagnostic tests-Glucose tolerance test (GTT), Glycosylated hemoglobin (HbA_1C). Glycosuria, Fructosuria and Galactosemia. Glycogen storage diseases. Amino acid metabolism: Phenylketonuria, Tyrosinemia and Alkaptonuria. Nucleic acid metabolism: Lesch-Nyhan syndrome. Lipid metabolism: Tay-Sachs disease, Nieman-Pick disease and Fabry disease.
Current Contours	**(Not for Final Exam, only for Discussion)** Case studies related to iron deficiency anemia. New diagnostic markers for liver diseases, kidney diseases, gastric and endocrine disorders. Pathophysiology of insulin resistance and diabetes.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	S	VS	VS
CO2	VS	VS	VS	VS	S
CO3	VS	VS	S	S	VS
CO4	S	S	VS	S	M
CO5	VS	VS	S	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Devlin, T. M. (2022). *Textbook of Biochemistry with Clinical Correlations an Indian Adaptation*, (7th ed.). Wiley India.
2. Burtis, C. A., Ashwood, E. R., & Bruns, D. E. (2014). *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics*, (5th ed.). Saunders, Elsevier Inc. Philadelphia.
3. Marshall, W. J., Lapsley, M., Day, A. P., & Ayling, R. M. (2014). *Clinical Biochemistry – Metabolic and Clinical Aspects*, (3rd ed.). Churchill Livingstone, Elsevier Ltd., UK.
4. Chatterjea, M. N., & Shinde, Rana. (2023). *Textbook of Medical Biochemistry*, (8th ed.). Jaypee Brothers Medical Publishers, New Delhi, India.
5. Godkar, P. B., & Godkur, D. P. (2014). *Textbook of Medical Laboratory Technology – Clinical Laboratory Science and Molecular Diagnosis*, (3rd ed.). Vol. 1. Bhalani Publishing House, Mumbai, India.
6. Sood, R. (2015). *Concise Book of Medical Laboratory Technology - Methods and*

Interpretations, (2nd ed.). Jaypee Brothers Medical Publishers (P) Ltd., New Delhi, India.

Related Online Contents:

1. https://www.ncbi.nlm.nih.gov/books/NBK499994/
2. https://www.ncbi.nlm.nih.gov/books/NBK544252/
3. https://www.ncbi.nlm.nih.gov/books/NBK551501/

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SEMESTER - VII

CORE COURSE -12: GENOMICS

Course Code	BM47C12	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				5	1	-	5		
Pre-requisite	Knowledge on genetics and molecular biology								

Course Objectives:

- To study the importance of genomics in health and diseases.
- To introduce various genomic tools for genomic analysis.
- To understand various approaches to diagnose, treat, and prevent genetic diseases and disorders

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Grasp application of various tools for genome analysis	K2
CO2	• Comprehend the concepts and recent discoveries in Genomics.	K1, K2
CO3	• Relate concepts and discoveries in genomics with Evolution.	K2
CO4	• Describe genomic architecture and candidate gene identification.	K3
CO5	• Know the importance of genetic analysis and pharmacogenmomics.	K1, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Introduction to Genomics - Structure and organization of prokaryotic and eukaryotic genomes; Human genome organization; History and goals of genome project; Genetic variation polymorphism, deleterious mutation; Phylogenetics; Tools for genome analysis - PCR, RFLP, DNA fingerprinting, RAPD, Automated DNA sequencing.
Unit II	Applied Genomics-Genomics in personal identification–Mitochondrial DNA, Gender Identification. Evolutionary Genomics-Neanderthal genome, Ancient Population and migration. Metagenomics-Environmental sample screening.

Unit III	Identification and Isolation of disease genes - Candidate gene identification; Genetic polymorphism and disease susceptibility; Markers from candidate gene / pathways; Whole genome association of variation - Single nucleotide polymorphism, CNVs.
Unit IV	Genome Databases- data banks and genome browsers- DNA microarray technology; Human Microarray and Transcriptomics; Next-Generation Sequencing.
Unit V	Pharmacogenomics and Personalized Medicine- Genetic variations on drug response; Testing for susceptibility to complex diseases; RNA and oligonucleotides therapeutics, Strategies and approaches in personalized medicine.
Current Contours	**(Not for Final Exam, only for Discussion)** Numerical Problems in Pharmacogenomics and Case histories of personalized medicines.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	S	VS	VS
CO2	S	VS	VS	S	S
CO3	VS	VS	VS	S	VS
CO4	VS	S	S	VS	M
CO5	VS	VS	VS	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Lesk AM. (2017). Introduction to genomics. Oxford University Press.
2. Strachan T, Read A. (2018). Human Molecular Genetics. Garland Science 4th Edition;
3. Brown TA. (2023). Genomes 5. CRC Press. 5th Edition.

Related Online Contents:

1. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/314
2. https://www.nature.com/articles/nrg3644

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SEMESTER - VII

CORE CHOICES COURSE-1: PROTEOMICS

Course Code	BM47C13P	Course Type	Core Choices	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on chemistry of proteins								

Course Objectives:

- To acquaint the proteome and proteomics and to study cell disruption methods.
- To understand different methods of protein extraction and purification techniques.
- To provide knowledge on protein expressions, analyses, post-translational modifications

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Define proteome and proteomics and its uses in various research fields.	K2
CO2	• Explain the cell disruption techniques and methods of isolation of cellular proteins.	K3
CO3	• Describe on extraction and separation of protein based on their solubility and size.	K2, K4
CO4	• Apply protein purification techniques in proteome research.	K2, K7
CO5	• Understand the expression of proteins, analysis and identification of proteome, and itsapplications.	K1
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Introduction and scope of Proteome and Proteomics – Getting Started with Protein Purification – Making Cell Free Extract – Cellular Disruption, Extraction Buffer, Protease Inhibitors, Methods of Cell Disruption – Subcellular Markers – Fractional Centrifugation – Protein Quantitation – Bradford Method.
Unit II	Manipulating proteins in solution – Stabilization and storage of proteins – Concentrating proteins from dilute solutions – Recovery of proteins by Ammonium sulfate Precipitation – Ultrafiltration – Lyophilization – Dialysis – Precipitating Agents – Ammonium sulfate, Acetone, PEG, TCA and Methanol-Chloroform precipitation.
Unit III	Protein Separation techniques: Chromatography techniques – HPLC, FPLC, Ion exchange, Gel filtration and Affinity chromatography. Tags and Recombinant proteins – Overexpression and purification of recombinant proteins – GST, His-tag, MBP, IMPACT, TAP-tag, Green Fluorescent Protein (GFP) and their applications – Protein databases and its applications.

Unit IV	Identification and Analyses of Proteomes: Strategies for protein identification, Electrophoretic techniques Two dimensional Polyacrylamide gel electrophoresis (2D-Gel) for proteome analysis – Identification of proteins on SDS gel - Mass Spectrometry based analyses of protein expressions – MALDI-MS, Protein sequencing, Protein microarrays, Protein chips and functional proteomics. Protein-protein interactions, Clinical and Biomedical applications of proteome analysis.
Unit V	Protein modifications and proteomics: Chemical modification – Active site directed modification, specific modifications – Glycosylation (N-glycosylation, O-glycosylation & Proteoglycans) Phosphorylation (Phosphoproteins) - Disulfides, Lipid modifications and applications.
Current Contours	**(Not for Final Exam, only for Discussion)** Screening and identification of biomarkers by plasma proteomics. Proteomic analyses in the diagnosis of diseases. Proteomic profiling of tissue proteins by mass spectrometry. Understanding cancer biology through proteomics. Forensic proteomics. Developing areas of proteomics and its impact on clinical research.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	M	VS
CO2	S	VS	M	S	S
CO3	VS	S	VS	VS	VS
CO4	VS	VS	VS	S	S
CO5	VS	VS	S	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Conn, P. M. (2003). Hand book of Proteomic Method. Publisher: Humana Press, Totowa,New Jersey, USA.
2. Simpson, R. J. (2003). Proteins and Proteomics. Publisher: IK International.
3. Twyman, R. M. (2004). Principles of Proteomics, Publisher: BIOS Scientific Publishers.
4. Stryer, L. (2007). Biochemistry. Publisher: W. H. Freeman and Co., New York.
5. Pennington, S.R., & Dunn, M. J. (2001). Proteomics - from protein sequence to function. Publisher: BIOS Scientific Publishers Ltd., UK.
6. Liebler. (2002). Introduction to Proteomics. Publisher: Humana Press.
7. Benjamin B. Sun, Karsten Suhre, Bradford W. Gibson. (2024). Promises and Challenges of populational Proteomics in Health and Disease, Molecular & Cellular Proteomics, Volume 23, Issue 7, 100786, ISSN 1535-9476, https://doi.org/10.1016/j.mcpro.2024.100786.
8. Jennifer Geddes-McAlister, Florence Roux-Dalvai, Arnaud Droit (2024), Chapter 18 - Proteomics, Bioinformatics, and Infectious Diseases, Editor(s): Michel Tibayrenc, Genetics and Evolution of Infectious Diseases (Third Edition), Elsevier, Pages 465-492, ISBN 9780443288180, https://doi.org/10.1016/B978-0-443-28818-0.00024-0.

Related Online Contents:

1. https://www.hsls.pitt.edu/obrc/index.php?page=proteomics
2. https://bmcgenomics.biomedcentral.com/articles/10.1186/s12864-022-09058-7
3. https://analyticalsciencejournals.onlinelibrary.wiley.com/journal/16159861
4. https://academic.oup.com/nar/article/50/D1/D543/6415112
5. https://www.ebi.ac.uk/training/online/courses/proteomics-an-introduction/what-is-proteomics/

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SEMESTER - VII

CORE CHOICES COURSE -1: ADVANCED MOLECULAR BIOLOGY

Course Code	BM47C13A	Course Type	Core Choices	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on cell and molecular biology								

Course Objectives:

- To describe the core principles of advance molecular biology.
- To understand the molecular basis of diseases and the advancements of molecular diagnostic techniques.
- To impart the mechanism of gene functions and regulations in prokaryotes and eukaryotes.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Clarify the central dogma of life in the cell	K4
CO2	• Understand the importance of diagnostic tools and analyse various therapeutic strategies.	K1, K2
CO3	• Understand the gene structure and properties.	K2
CO4	• Knowledge on Gene Expression at transcription and translation level in Prokaryotes.	K1
CO5	• Describe the principles and controls of gene regulation in Eukaryotes.	K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	**Structure and Properties of Nucleic acids:** Nucleic acid as the genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment)- Components of DNA and RNA -Watson and Crick model of DNA structure, Various forms of DNA- Physical properties of nucleic acids; Denaturation and renaturation, Cot curves – Structure and function of mRNA, rRNA, tRNA- Chromatin structure-Euchromatin, Heterochromatin- Central Dogma of Molecular Biology.
Unit II	**Molecular Diagnostic Technologies:** PCR-Based Methods, Next generation sequencing techniques, Microarray Approaches to Gene Expression Analysis. Comparative genomic hybridization (CGH), ELISA, Prenatal and postnatal genetic tests.

Unit III	**Gene Structure:** Prokaryotic and Eukaryotic gene structure and function. Cistron and recon, gene transfer in bacteria, conjugation, transformation, transduction, sexduction, complimetation and recombination, allelism, mapping of gene.
Unit IV	**Control of Gene Expression:** Prokaryotic operon structure and function: Control of Gene Expression at transcription and translation level in Prokaryotes - Constitutive, inducible and repressible gene expression, Positive and Negative control of gene expression, Lac, Tryptophan, arabinose operons; Concept of attenuation, lytic cascade and lysogenic repression in lambda bacteriophage.
Unit V	**Amplification of Signal and Gene Silencing:** Eukaryotic operon structure and function, gene clusters, genes in organelles. Control of Gene Expression at transcription and translation level in Eukaryotes - Eukaroytic genome organization, Proteins involved in the control of transcription, protein-protein interactions. Ligand binding to membrane receptors and its role in regulating transcription, phosphorylation cascade and amplification of signal. Role of chromatin in regulating gene expression and gene silencing.
Current Contours	**(Not for Final Exam, only for Discussion)** Genome sequencing Tools-Gene expression and analyzing Methods-Synthetic genome -Future of molecular biology in medicine. Recent advancements and technology in translational research.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	VS
CO2	VS	VS	S	VS	M
CO3	VS	VS	VS	VS	VS
CO4	VS	S	VS	M	S
CO5	VS	VS	S	VS	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. (2002). Molecular Biology of the Cell. 4th Edition Bruce Alberts. New York: Garland Science.
2. David L. Nelson, Michael M. Cox. (2008). Lehninger Principles of Biochemistry .5th Edition. W. H. Freeman.
3. Rob Elles and Roger Mountford. (2004). Molecular diagnosis of genetic diseases, 2nd Edition. Humana Press.
4. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Inglis CSHLP (2007). Molecular Biology of the Gene. 6th Edition. Pearson Benjamin Cummings.
5. Arnold Berk, Chris A. Kaiser, Harvey Lodish, Angelika Amon, Hidde Ploegh, Anthony Bretscher, Monty Krieger, Kelsey C. Martin. (2016). Molecular Cell Biology. 8th Edition. W. H. Freeman & Co Ltd.
6. David, Freifelder. (2004). Molecular Biology. Narosa.
7. Michael M. Cox, Jennifer A. Doudna, Micheal O' Dennell. (2011). Molecular Biology: Principles and Practice. 2nd Edition. W. H. Freeman & Co Ltd.
8. Burton E. Tropp. Molecular Biology: Genes to Proteins. (2011). 4th Edition. Jones & Bartlett Learning.
9. Lizabeth A. Allison. Fundamental Molecular Biology. (2006). 1st Edition. John Wiley & Sons.

Related Online Contents:

1. https://www.umu.se/en/education/courses/advanced-molecular-biology2/
2. https://www.quora.com/What-are-the-best-resources-to-learn-about-molecular-biology
3. https://researchbysubject.bucknell.edu/c.php?g=25629&p=156817
4. https://www.thermofisher.com/in/en/home/brands/thermo-scientific/molecular-biology/molecular-biology-learning-center/molecular-biology-resource-library.html

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SEMESTER - VII

ELECTIVE COURSE -1: CELL SIGNALING

Course Code	BM47E1C	Course Type	Elective	L	T	P	C	Syllabus version	2022-2023
				4	1	-	4		
Pre-requisite	General principle of cell communication in multicellular organisms								

Course Objectives:

- To provide an overview on signal transduction, diverse forms of signaling molecules, various types of receptors and signaling pathways.
- To explain the concept of neuronal signaling pathway, neurotransmitters and mechanism of muscle contraction.
- To understand the role of signal proteins in cellular functions and their defects in disease.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Discuss the importance and effects of cell signaling process in primitive and multicellular organism.	K4
CO2	• Highlight the role of ligands, receptors, second messengers and signaling proteins in signal transduction pathways.	K5
CO3	• Describe the principle and mechanism of sensory transduction and nerve cell communication.	K2, K4
CO4	• Explain structure of GPCR and RTKs and downstream signaling pathways.	K2, K7
CO5	• Gain knowledge on signaling pathways involved in cancer pathogenesis.	K1, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Definition – Signal transduction, stimulus, effectors; Need for signaling, Cell signaling in primitive organisms - *E. coli* and yeast; Effects of cell signaling - cell differentiation, cell proliferation, cell survival, metabolism and other cellular functions.
Unit II	Mechanisms of paracrine signaling, synaptic signaling, endocrine signaling, autocrine signaling; Sensory transduction: Nerve impulse transduction - nerve cells, synapses, reflex arc, impulse transmission and voltage gated ion-channels.
Unit III	Cell surface receptors – G protein coupled receptors – structure, mechanism of signal transduction, regulatory GTPases, effector molecules of G proteins; Signaling molecules and second messengers – cAMP, cGMP, DAG, NO and Ca^{2+} ions.
Unit IV	Receptor tyrosine kinases, signal transmission via Ras and MAP kinase pathways; Nuclear receptors – mechanism of action of steroid hormones, cytokine receptors – activation of cytokine receptors, Jak-Stat pathway.

Unit V	Errors of signal proteins and tumourigenesis, p53 signaling pathway and tumour suppression, APC and Wnt/β Catenin Signaling.
Current Contours	**(Not for Final Exam, only for Discussion)** Targeting G protein coupled receptor in cancer therapy, **Notch signaling,** Wnt/β Catenin signaling pathway and therapeutic opportunities.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	S	VS	M	VS
CO2	VS	VS	S	VS	S
CO3	VS	VS	VS	S	M
CO4	S	VS	S	S	S
CO5	S	VS	VS	M	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Gerhard, K. (2014). *Biochemistry of Signal Transduction and Regulation*, (4th ed.). Wiley-VCH Publication.
2. Cooper, G. M., & Hausman, R. E. (2007). *The Cell: A Molecular Approach*, (4th ed.). ASM Press, and Sinauer Associates, Inc., USA.
3. Lodish, H., Berk, A., Kaiser, C. A., Bretscher, A., Ploegh, H., Amon, A., & Scott, M. P. (2013). *Molecular Cell Biology*, (7th ed.). W. H. Freeman and Company, USA.
4. Bruce, A., & Alexander, J. (2015). *Molecular Biology of the Cell*, Garland Science.
5. Hancock, J. T. (2017). *Cell Signalling*, (4th ed.). Oxford University Press, New York.
6. Helmreich, E. J. M. (2001). *The Biochemistry of Cell Signalling*, Oxford University Press, New York.

Related Online Contents:

4. https://doi.org/10.1016/B978-0-12-369441-6.X0001-3
5. https://doi.org/10.3389/fncel.2021.761416
6. https://doi.org/10.3892/etm.2020.8454

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SEMESTER - VII

ELECTIVE COURSE 1 -: REPRODUCTIVE BIOLOGY AND HEALTH

Course Code	BM47E1R	Course Type	Elective	L	T	P	C	Syllabus version	2022-2023
				4	1	-	4		
Pre-requisite	Knowledge on Human anatomy and physiology								

Course Objectives:

• To understand male and female reproductive system
• To learn disorders associated with human reproductive system
• To gain knowledge on reproductive health care for better outcome of pregnancy.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend the concept on genetic counseling and prenatal diagnosis and their role in prevention of child being born with a genetic disease.	K1, K2, K7
CO2	• Understand the concept of twin conception and risk associated with multiple pregnancies.	K1, K2
CO3	• Provide information to the needy regarding advanced techniques (Assisted reproductive techniques) availability for the treatment of infertility.	K1, K2, K4
CO4	• Understand the Importance of preconception care and antenatal care for the better outcome of pregnancy and benefits of contraceptives in health care.	K1, K2
CO5	• Gain knowledge on causes, diagnosis and prevention of high risk pregnancies for better outcome of pregnancy.	K1, K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Fundamentals of Human reproductive system: Introduction-Anatomical structures - Male and female, Sexual differentiation during development, Gonadal dysgenesis, Congenital Anomalies – in male (Cryptorchidism, Hypospadias Varicocoel, Spermatocoel) and female (Mullerian duct anomalies, Undescended ovaries, ovarian agenesis and vaginal atresia) reproductive system, male/female pseudo hermaphroditism. Gametogenesis - Oogenesis & Spermatogenesis, Ovulation, Fertilization. Twin Conception – Formation and Development - Identical and Fraternal.

Unit II	Role of hormones in male reproductive physiology: Endocrine control of testicular function- GnRH and Pituitary Gonadotropins, inhibin and prolactin. Physiological roles of Androgens – Spermatogenesis, secondary sex characteristics, anabolic actions and ageing. Mechanism of Androgen action- Androgen receptors. Physiological roles of estrogens- fertility, male behavior, Epiphyseal fusion.
Unit III	Role of hormones in female reproductive physiology: Ovarian steroid hormones (OSH)- Estrogen, Progesterone, Androgens and their mechanism of action -Estrogen receptors. Physiological roles of OSH, prostaglandins, oxytocin and vasopressin. Mammalian reproductive cycle –Primate menstrual cycle, induced and spontaneous ovulators, delayed implantation Menopause and hormone replacement therapy.
Unit IV	Disorders of Reproductive system: Infertility: Causes - Male factors and female factors, Couple Dependent Factors, Toxic Exposures. Methods of IVF - ICSI, ZIFT, GIFT and PGD, disadvantages of IVF. Embryo cryopreservation and sperm bank. Recurrent pregnancy loss: Causes and treatment– Genetic, Hormonal, Metabolic and other factors; Rh incompatibility- overview. Pathophysiology - Dysmeorrhoea, Amenorrhea, Polycystic Ovary Syndrome, premature ovarian failure, premenstrual syndrome, Infections in Pregnancy, High risk pregnancy-Causes, Diagnosis and prevention.
Unit V	Genetic defects and reproductive health: Principle of teratology and teratogenic agents, Pre-conception Counseling – Preconception care -reproductive history, preconception risk assessments, medical assessment, nutritional assessment, social assessment, family history-Carrier screening X-linked recessive and autosomal recessive disorders - other factors assessment. Brief introduction - Contraceptives - Antenatal Care and Risk assessment –Methods for prenatal diagnosis of genetic defects –Amniocentesis and chorionic villus sampling. Reproductive Health - WHO definitions and indicators of reproductive health.
Current Contours	**(Not for Final Exam, only for Discussion)** Discuss few clinical reports on ART and its success rates in India and western countries. Collect information from published data in India regarding prenatal diagnosis adopted for genetic diseases.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	S	M	S
CO3	VS	VS	VS	S	VS
CO4	S	VS	S	VS	M
CO5	VS	S	VS	S	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Hiralal Konar.(2020). D.C Dutta's Textbook of Gynaecology 8th edition.
2. Mac E. Hadley and Jonathan Levine. (2009). Endocrinology 6th edition.
3. Narendra Malhotra et al. (2014). Jeffcoate's Principles of Gynecology 8th edition.
4. Sengupta *et al*. (2007). Gynaecology for postgraduates and Practitioners 2nd edition,

Related Online Contents:

1. https://www.nature.com/subjects/reproductive-biology
2. https://www.studocu.com/en-au/document/australian-national-university/human-biology/lecture-notes-lectures-1-9-reproduction/311871
3. https://www.studocu.com/en-au/document/the-university-of-edinburgh/reproductive-biology-3/lecture-notes/reproductive-biology-3-l5/1087563
4. https://www.nature.com/subjects/reproductive-biology

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SEMESTER - VII

LABORATORY COURSE -7: CLINICAL BIOCHEMISTRY

Course Code	BM47CP6	Course Type	Laboratory course	L	T	P	C	Syllabus version	2022-2023
				1	-	4	3		
Pre-requisite	Fundamental knowledge on biochemical processes in human body								

Course Objectives:

- To gain basic knowledge on specimen collection, processing and separation of sample.
- To perform biochemical measurements in clinical samples (Blood and urine).
- To analyse normal and abnormal constituents in blood and urine samples.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend the collection and preservation of biological fluid blood and urine.	K1, K3
CO2	• Prepare various standard solutions and buffers for the tests.	K5
CO3	• Estimations biochemical constituents in serum using spectrophotometer.	K7
CO4	• Analyse qualitatively and quantitatively urine constituents.	K4
CO5	• Assess the activity of the serum marker enzymes using standard methods.	K7
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Experiments

List of Practical:

1. Blood and urine collection methods and processing of sample.
2. Biochemical estimation in blood:
   - ✓ Glucose
   - ✓ Cholesterol.
   - ✓ Urea
   - ✓ Creatinine
   - ✓ Uric acid
   - ✓ Total Proteins and A/G ratio
   - ✓ Bilirubin
3. Biochemical estimation in urine:
   - ✓ Urea
   - ✓ Uric acid
   - ✓ Creatinine
4. Qualitative analysis of normal and abnormal constituents of urine.

5. Enzyme Assays in serum:
    a. Measurement of transaminases (SGOT and SGPT) activity.
    b. Measurement of lactate dehydrogenase (LDH) activity.
    c. Measurement of alkaline phosphatase (ALP) activity.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	VS	VS
CO2	VS	VS	VS	S	VS
CO3	VS	VS	VS	VS	S
CO4	VS	VS	S	VS	M
CO5	VS	S	VS	S	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Varley, H. (2006). *Practical clinical biochemistry*, (6th ed.). CBS Publishers & Distributors. India.
2. Talib, V. H. (2019). *Handbook medical laboratory technology*, (2nd ed.). CBS Publishers & Distributors. India.
3. Talib, V. H. (2020). *Practical textbook of laboratory medicine*, (2nd ed.). CBS Publishers & Distributors. India.
4. Plummer, D. T. (2001). *Introduction to practical biochemistry*, (3rd ed.). McGraw-Hill. New Delhi, India.
5. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry*, (2nd ed.). New Age International, India.
6. Shivananda, N. B. (2024). *Manipal Manual of Clinical* Biochemistry, (5th ed.). Jaypee Brothers Medical Publishers (P) Ltd, India.

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SEMESTER - VIII

CORE COURSE -13: GENETIC ENGINEERING

Course Code	BM48C14	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on molecular biology and biotechnology								

Course Objectives:

- To understand the basic principles of gene cloning and DNA analysis.
- To study the gene manipulation strategies .
- To describes the production of recombinant proteins and its applications

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Research branch where virtual genetic models are created using computer software.	K1
CO2	• Explore all of the understanding of gene cloning in an approachable way	K1, K2
CO3	• Advanced the understanding of many theoretical and practical aspects of gene function and organization.	K3, K4
CO4	• One can use non-virtual genetic engineering tools to manipulate the genes of living organisms for cloning, introducing new characteristics to an organism or anything else to do with physical tools.	K7
CO5	• Can deal with separating, classifying and preparing genes for applied genetic engineering experiments and activities.	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Basic Principles of Gene cloning and DNA analysis. Advent of gene cloning and PCR, cloning vectors, prokaryotes, eukaryotes: Plant-Ti plasmid, Insects-P-element (drosophila), vectors based on lambda bacteriophage, M13 bacteriophage, Artificial chromosomes. In-vitro transcription of cloned DNA, Different strategies of cloning, Restriction enzyme, Homopolymeric tailing, adaptor and linkers, Enzymes used in Genetic Engineering.
Unit II	Studying Gene location of small and large DNA molecule. Localization by In situ hybridization of eukaryotic chromosome, by gel electrophoresis. DNA sequencing methods. Sangers's sequencing, Reading the DNA sequence from the autoradiograph, Automated DNA sequencing, Sequencing PCR products, Maxam-Gilbert methods, Building up a long DNA sequence.

Unit III	Studying transcript of cloned gene: Electron microscopy of a nucleic acid. Transcript analysis by primer extension, Other technique for studying RNA transcript. Regulation of gene expression, Identifying protein binding sites on a DNA, Foot printing with DNase I, Modifying with interference assays, Identifying control sequences by deletion analysis, Reporter gene and carryingout a deletion analysis.
Unit IV	Analysis of protein by in vitro mutagenesis, Different types of in vitro mutagenesis Protein Engineering, Increasing enzymatic activity Modifying metal cofactor requirements, Modifying enzymes specificity, increasing enzyme stability and specificity.
Unit V	Production of protein from cloned genes in E.coli, yeast, Insect cells, mammalian cells. Example of promoters used in expression vectors, Cassettes and gene function, General problem with production of recombinant protein in E.coli. Gene cloning and DNA analysis in medicine, Production of recombinant insulin synthesis and expression of artificial insulin gene. Syntheses of hGH in E.coli. Recombinant factors Viii and other human proteins
Current Contours	**(Not for Final Exam, only for Discussion)** CRISPR-Cas Systems: Base Editing, prime editing, Multiplex CRISPR. Gene Therapy: In Vivo Gene Editing. Synthetic Biology, Synthetic Genomes. Gene Drives. Epigenome Editing, Organoid Development and Disease Modeling, mRNA-Based Technologies

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	S	VS	S	VS	S
CO3	VS	S	VS	VS	VS
CO4	VS	VS	S	M	S
CO5	VS	VS	M	VS	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. TA Brown. (2010). Gene cloning and DNA analysis – An introduction by 6th edition Wiley-Blackwell.
2. Desmond ST Nicholl. (2002). An introduction of genetic engineering 2nd edition Cambridge university press.
3. Watson JD. (1992). Recombinant DNA. New York. Scientific American Books.
4. Kerbs JE, Goldstein ES, Kilpatrick ST. (2018). Lewin's Gene XII e Book, Jones & Bartlett Learning.
5. EL WinNacker. (1987). From Genes to Clones: Introduction to Gene Technology. Weinheim, Federal Republic of Germany: New York.
6. E.F Sambrook, J., Fritsch, EF and Maniatis T Plainview, NY (1989). Molecular Cloning: A laboratory Manual. Cold Spring Harbor Laboratory press
7. Boti MA, Athanasopoulou K, Adamopoulos PG, Sideris DC, Scorilas A. (2023). Recent Advances in Genome-Engineering Strategies. Genes (Basel). Jan 2;14(1):129. doi: 10.3390/genes14010129. PMID: 36672870; PMCID: PMC9859587

Related Online Contents:

1. Future Genetic-Engineering Technologies: Past Experience and Future Prospects. Genetically Engineered Crops: Experiences and Prospects. Washington (DC): National Academies Press (US); 2016 May Available from: https://www.ncbi.nlm.nih.gov/books/NBK424553/ Osmosis from Elsevier

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SEMESTER - VIII

CORE COURSE -14: IMMUNE AND MOLECULAR DIAGNOSTICS

Course Code	BM48C15	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on immunology and molecular biology								

Course Objectives:

- To understand the immunological techniques in the disease diagnosis.
- To impart knowledge on protein based molecular diagnostic techniques.
- To equip students to correlates molecular diagnostics and clinical significance

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Know about the applications of various immunological techniques in the disease diagnosis.	K1, K2
CO2	• Comprehend about the applications of molecular based techniques in the disease diagnosis.	K1, K2
CO3	• Relate the importance and advantages of molecular techniques over conventional methods in disease diagnosis.	K1, K2, K4
CO4	• Understand the importance of DNA based molecular techniques in the prenatal screening, forensic investigations, HLA typing and genetic disease diagnosis	K1, K2, K7
CO5	• Impart the importance of quality assessment program in clinical laboratories.	K1,K2, K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Basic Immunological Methods – Preparation of antigens, rising of antisera, routes of administration, doses for administration, purification of antibodies-methodology – IgG & IgA. Monoclonal antisera raising & Hybridoma technology. Types of conjugated antibodies, types of substrates and color detectors used in immunoassays. Immunoflurescence, Flow cytometry -clinical focus – Leukemia typing (immunophenotyping), ELISA and its variants-Principle and application, Surface Plasmon Resonance- principle and application-western blotting- principle and application.
Unit II	Serodiagnostics – Define Acute & Convalescent sera, collection of serum specimen, storage, preparation of dilutions. Serodiagnosis of various infectious diseases - Detection of antibodies to microbial antigen – Syphilis, typhoid, streptococci infections, HIV, Hepatitis B and C - Comments on respective clinically specific antigens, Overview of clinical significance of various autoantibodies and diagnostic methods involved in the detection. Overview of

	diagnosis of complement disorders and clinical significance of C3nephritic factor and complement deficiencies.
Unit III	Clinical significance of measurements of specific proteins in serum, CSF & Urine - Immunoglobulins (Igs), paraproteins & cryoglobulins, Functional assays for immune complexes. Clinical significance of C-Reactive proteins - cryoglobulins in patient specimens- test methods for detection. Tests for allergy-–Total serum IgE, Allergen specific IgE – serology based methods -in vivo -skin test, in-vitro – RAST (1st, 2nd & 3rd generation methods) – cell based methods -Allergen induced mediator release assay – Histamine release, LTC4 release (Cellular antigen Stimulation Test-CAST), Flow cytometric basophil activation assay (Flow assay Stimulation Test-FAST) - CD63 CD203c.
Unit IV	Basic Molecular Methods: Types of mutations- PCR based mutation detection methods – for known & unknown mutations – ASP, ASOP, TTGE, DGGE, Heteroduplexing method, SSCP & sequencing. Micro (STRs) and minisatellites (VNTRs) Analysis- principle and applications. Discuss: Primer designing for PCR. Collection, processing and storage of sample –RNA extraction- cDNA preparation, RT-PCR –Principle, methods & Applications - Real time PCR – Principle, methods & Applications. Types of dyes (SYBR Green) and probes (Taq-Man). FISH- Principle and Application.
Unit V	Molecular Diagnostics –Diagnosis of Mycobacterium tuberculosis, HCV & HIV; Conventional vs. Molecular Diagnostics –Merits & Demerits. Molecular diagnosis of single gene disorder - sickle cell anemia- Molecular HLA typing – Sequence specific PCR (SSP), Sequence specific oligonucleotide probe (SSOP), Sequence Based Typing (SBT) - Advantages of molecular HLA typing over serological methods-HLA typing (Microlymphocytotoxicity Assay) and clinical significance-Comment on Sensitivity and Specificity of clinical laboratory techniques – Quality assessment Programs (external & internal assessment Programs).
Current Contours	**(Not for Final Exam, only for Discussion)** Recent advances of next generation sequencing in clinical application.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	S	VS	S
CO3	VS	S	VS	S	M
CO4	VS	VS	S	M	VS
CO5	VS	S	VS	VS	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Janis Kuby. (2011). Immunology 6th edition
2. Peter J.Delves, Seamus J.Martin, Dennis R.Burton and Ivan M.Roitt. (2017). Roitt's Essential Immunology 13th Edition
3. Helen Chapel, Mansel Haeney, Siraj Misbah and Neil Snowden. (2014). Essentials of Clinical Immunology 6th Edition
4. R.G.H.Cotton, E.Edkins and S.Forrest. (1998). Mutation Detection, A Practical Approach.

Related Online Contents:

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC7474384/
2. https://pmc.ncbi.nlm.nih.gov/articles/PMC7381402/
3. https://www.mdpi.com/2079-6374/13/4/490
4. https://link.springer.com/chapter/10.1007/978-981-10-0875-7_9

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SEMESTER - VIII

CORE CHOICES COURSE -2: NEUROBIOLOGY

Course Code	BM48C16N	Course Type	Core Choices	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Fundamental knowledge on anatomy and physiology								

Course Objectives:

- To define the molecular, cellular, and tissue-level organization of the central and peripheralnervous system
- To understand the properties of cells that make up the nervous system including the propagation of electrical signals used for cellular communication
- To relate the properties of individual cells to their function in organized neural circuits andsystems

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Explain the basic components of neurobiology	K1
CO2	• Develop competency in quantitative reasoning and research methodology in neuroscience	K1, K2
CO3	• Evaluate and discuss primary research literature in neurobiologyand evaluate the validity of hypotheses generated by others	K1, K7
CO4	• Perform on research projects independently in neurobiology.	K2, K3
CO5	• Analyze cognitive functions associated with neuro degenerative diseases .	K1, K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Brain Anatomy and function. Energy sources (oxygen and glucose delivery) and metabolism of Brain. CNS, CSF, BBB. Meninges. Embryonic development of Brain. Normal sensation, Movement, and homeostasis. Maintenance of homeostasis, Motor hierarchy controls, Cortex control center to voluntary movement. Function of cerebellum, and Glial cells.
Unit II	Excitable Tissue: Nerve, Excitation and Conduction, membrane potentials, all-or-non law, salutatory conduction, orthodromic and antidromic conduction. Ionic basis of RMP, Synaptic transmission - Properties of Chemical and Electrical synapses – A model synapse: NMJ,, Motor Unit, tension, muscle spindles- orderly recruitment, EMG, stretch reflex, Presynaptic exocytosis is Ca 2+ dependent -– the Interplay of Excitation and Inhibition - Synapses and Specialized Short term and long-term Synaptic Plasticity.

Unit III	Pre-and Post Synaptic Receptors - Receptor structure and function - Neurotransmitters Neurohormones, Neuromodulators. Biogenic Amines Catecholamines, Serotonin and Histamine- GABA, Glutamate and Glycine - Nitric oxide - Neuroactive peptides - Hypothalamic neurohormones - Opiate peptides - other peptide.
Unit IV	Nervous system and pain. spinal cord: Brain somato sensory cortex ascending and descending pain pathways, gate control theory. Categories of pain. Nociceptor. Processing of sensory information, somatic sensory pathway. neuro pathway: somato sensory system, general sensory pathway, classification of sensory receptors.
Unit V	Paraneoplastic diseases, encephalomyelitis, cerebellar degeneration, opsoclonus-myoclonus, Neurodegenerative diseases. CNS, PNS, Demyelination disease, Charcot-Marie-Tooth disease, Multiple sclerosis, Acute disseminated encephalomyelitis, Central pontine myelinolysis. Parkinson's disease, Huntington's disease, Alzheimer's disease, Intracerebral hemorrhage, hemorrhage stroke. Polio.
Current Contours	**(Not for Final Exam, only for Discussion)** Brain-age gaps Personalized neural markers, Neuro-technologies, Brain organoids. Non-invasive brain circuit control, Berries and cognitive health, Using nano-technology to repair damaged brain tissues.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	S	S	VS
CO3	S	VS	VS	VS	S
CO4	S	VS	VS	S	M
CO5	VS	S	M	VS	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Ed. Michael Conn P. (2018). Neuroscience in Medicine Second Edition.
2. Kim Barrett, Heddwen Brooks, Scott Bitano, Susan Barman. (2019). Ganong's Review of Medical physiology 23rd or 24th Edition.
3. Loscalzo., Fauci A., Kasper D, Hauser S, Longo D, Jameson, JL. (2022). Principle of Internal Medicine by Harrison. 21st Edition.
4. Dee Unglaub Silverthorn. (2016). Human Physiology, An Integrated approach 7th edition.
5. Ropper AH., Samuels MA., Klein, J. (2014). Principle of Neurology by Adams & Victor 8th edition.
6. Schoenwolf, Bleyl, Brauer and Franscis-West (2020). Larsen's Human Embryology E Book Elsevier Health Sciences.
7. Zeder, K., Siew, E.D., Kovacs, G. *et al.* Pulmonary hypertension and chronic kidney disease: prevalence, pathophysiology and outcomes. *Nat Rev Nephrol* (2024). https://doi.org/10.1038/s41581-024-00857-

Related Online Contents:

1. Critical Revies in Neurobiology: ISSN Online 2375-0041 Editor: Markad Kamath
2. https://www.youtube.com/watch?v=EjZOtfhBp4A&t=562s by Medicosis Perfectionalis
3. youtube channel: by Biophyll
4. https://www.dailymotion.com/video/x2ohy3c
5. www.medicalnote.in
6. Osmosis from Elsevier

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SEMESTER - VIII

CORE CHOICES COURSE -2: MOLECULAR MEDICINE

Course Code	BM48C16M	Course Type	Core Choices	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic knowledge on biochemistry, cell biology and genetics								

Course Objectives:

- To emphasis the Molecular basis of diseases and the advancements of MolecularDiagnostic Technologies.
- To understand the Signal transduction and its role in human diseases and therapeutic strategies.
- To emphasize molecular mechanism of various diseases such as HIV,HCC, Tuberculosis, Dengue, SARS and the challenges in antimicrobial resistance.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Describe human genetics relevant to diseases and identification of genes in diseases	K1
CO2	• Understand the impact of Gene-environment interaction on disease	K3, K7
CO3	• Analyze the signal transduction pathways and its role in human diseases	K1, K4
CO4	• Explain the basic concepts of AYUSH and its range of natural products usage for treatingvarious human ailments.	K2
CO5	• Understand the importance of diagnostic tools and analyse various therapeutic strategies.	K1, K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Molecular basis of diseases: Human genetics relevant to diseases, DNA polymorphism, Single (Cystic fibrosis, Huntington‟s disease, Familial hypercholesterolemia, Dunchenne muscular dystrophy, red-green colour blindness, Tay-Sachs diseases, pearson syndrome& Xeroderma pigmentosum) and polygenic diseases (Asthma & Diabetic mellitus), Omics, Gene-environment: Interactions in disease manifestation and inheritance, genetic and physical mapping of human genome and identification of genes in diseases.
Unit II	Molecular Diagnostic Technologies: PCR-Based Methods, Next generation sequencing techniques, Microarray Approaches to Gene Expression Analysis. Comparative genomic hybridization (CGH), ELISA, Prenatal and postnatal genetic tests.

Unit III	Signal transduction and its role in human diseases: Cellular and tissue microenvironment in diseases, Defects in G protein-coupled signal transduction in human disease, TGF-β, MAPK, PI3K/Akt, Notch & JAK-STAT signaling pathways in human diseases, Inhibiting signaling pathways through rational drug design.
Unit IV	Therapeutics Strategies: Translational research (bench to bedside), Mechanism of action and clinical application of Antisense Oligonucleotides, Gene therapy, Personalized Medicine, Stem cell therapies, RNAi & microRNA in human diseases, Monoclonal Antibodies, CRISPR/Cas technology-AYUSH, Plants and microbes as sources of natural metabolites, Healing herbs in Traditional medicinal system (Curcuma longa and Yukyung Karne). TKDL.
Unit V	Molecular Mechanisms and Challenges: RNA and DNA viruses of humans causing diseases; Corona virus SARS-CoV-2, HBV related HCC, HIV, Dengue fever- Parasitic disease; Leishmaniasis, African trypanosomiasis and Malaria- Bacterial diseases: Tuberculosis (TB), Pneumonia & Cholera- Superbugs and Antimicrobial resistance (Staphylococcus aureus)- Multi drug resistance issues & future challenges.
Current Contours	**(Not for Final Exam, only for Discussion)** Marburg virus &Ebola virus- De novo synthesis of small molecular inhibitors for target - based treatment- Immunotherapy - Recent advancements and technology in translational research.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	VS
CO2	VS	VS	VS	VS	S
CO3	VS	VS	S	M	VS
CO4	VS	S	VS	VS	S
CO5	VS	VS	S	VS	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Littwack, G. (2008). Human Biochemistry and Disease. Academic Press.
2. Trent, R. J. (2012). Molecular Medicine, Fourth Edition: Genomics to Personalized Healthcare. Academic Press.
3. Trent, R. J. (2005). Molecular Medicine: An Introductory Text. Academic Press.
4. Elles, R., Mountfield, R. (2011). Molecular Diagnosis of Genetic Diseases. Springer Publication.
5. Liciniio, J., Wong, M. L. (2003). Pharmacogenomics: The Search for Individualized Therapies. Wiley-VCH Verlag GmbH & Co. KGaA.
6. Audet, J., Stanford, W. and Stanford, W. L. (2009). Stem cells in regenerative medicine. New York, Humana press.
7. Buckingham and Flaw's. (2007). "Molecular Diagnostics: Fundamentals, Methods and Clinical Applications", F.A. Davis Company; First edition.
8. Toren Finkle & J. Silvio Gutkind. (2003). Signal transduction and human diseases, (Wiley online library)

Related Online Contents:

1. https://www.malariaworld.org/blogs/malaria-vaccine-who-position-paper-may-2024
2. https://www.mdpi.com/2673-8112/4/2/12
3. https://www.who.int/teams/immunization-vaccines-and-biologicals/policies/position - papers/dengue

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SEMESTER - VIII

ELECTIVE COURSE -2: SOCIAL AND PREVENTIVE MEDICINE

Course Code	BM48E2S	Course Type	Elective	L	T	P	C	Syllabus version	2022-2023
				4	1	-	4		
Pre-requisite	Knowledge on human disease and health								

Course Objectives:

- To explain the principle of Epidemiology and Epidemiological Diseases.
- To study communicable and non-communicable disease and its preventive methods.
- To gain knowledge on Health Programmes and Laws in the field of community health in India.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend the concept of Health and Disease and principles of epidemiology.	K1
CO2	• Know the epidemiological data on common communicable & non-communicable diseases in India.	K1
CO3	• Understand about Health Programmes in India for the control of various infectious diseases and Health Programmes for welfare of the child & motherhood.	K1, K2
CO4	• Understand about the benefits of Immunization Programme	K1, K2
CO5	• Understand about the Laws enacted for the protection of child, prevention of adulteration and various laws in the field of community health	K1, K2, K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	History of different systems of Medicine; Public health events - Sanitary awakening, germ theory of disease, rise of Public health in various countries; Primary Health.
Unit II	Concept of Health and Disease- Preventive Medicine, Social Medicine, Definition of health, Dimension of health, Spectrum of health, Determination of health and Indicator of Health. Natural history of disease, concept of disease control, Levels of prevention, and modes of intervention for diseases and condition, International classification of diseases and coding system.

Unit III	Principle of Epidemiology and Epidemiological Diseases - Aims of epidemiology, epidemiological approaches, rates and ratios, measurements of mortality, measurement of morbidity, epidemiological and methods, descriptive epidemiology, analytical epidemiology and Experimental Epidemiology. Uses of epidemiology, Investigation of an epidemic, International death certificate.
Unit IV	Epidemiology of diseases – Communicable diseases- Measles, Rubella, Mumps, Chicken Pox, Acute Respiratory infection, Diphtheria, pertussis and tetanus, Tuberculosis, Poliomyelitis, Viral Hepatitis, Acute Diarrhoeal diseases, Arthropod borne infections - Malaria, Filariasis, Dengue syndrome, Rabies, Plague, Japanese Encephalitis, Leishmaniasis, Leprosy, Sexually transmitted diseases and Acquired Human immunodeficiency syndrome. Epidemiology of chronic non -communicable diseases- Coronary heart disease, Hypertension, stroke, Rheumatic heart disease, cancer, diabetes, obesity, Blindness, Accidents etc.
Unit V	**Health Programmes in India** - National Malaria Eradication Programme National Fileria Control Programme National Tuberculosis Control Programme National Leprosy Eradication Programme Acute Diarlocal diseases Control Programme Guinea warm Eradication Programme Iodine deficiency disorders control programme National Programme for Control of Blindness National Cancer Control Programme National Mental Health Programme Child Surviod and Safe Motherhood Programme Reproductive and child health Programme Universal Immunization Programme National Family Welfare Programme National Nutritional Programme. **Laws in the field of community health** - The prevention of food adulteration Act, 1954 - The Medical termination of pregnancy Act 1971 - The Employees State Insurance Act 1948 - The Indian Factories Act 1948 - The Central Maternity Benefit Act 1961 - The Children Act 1960 - The Central birth and death registration Act 1969 - The epidemic diseases Act 1897 - Juvenile Justice Act 1986 - The Tamil Nadu Public Health Act.
Current Contours	**(Not for Final Exam, only for Discussion)** Know briefly about Nutrition and Health and influence of environment on Health. Comment on emerging and re-emerging infectious diseases- Hospital acquired infections.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	M
CO2	VS	VS	S	VS	S
CO3	VS	VS	VS	S	S
CO4	S	VS	S	VS	VS
CO5	VS	S	S	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. K. Park. (2023). Text Book of Preventive and Social Medicine 27th edition.
2. Parimal Patel & Khushbu Makadia. (2024). Golden Notes for Preventive and Social Medicine 3rd edition Jaypee Brothers Medical Publishers

Related Online Contents:

1. https://www.who.int/news-room/fact-sheets

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SEMESTER -VIII

ELECTIVE COURSE -2: DRUG DISCOVERY AND ASSAY DEVELOPMENT

Course Code	BM48E2D	Course Type	Elective	L	T	P	C	Syllabus version	2022-2023
				4	1	-	4		
Pre-requisite	Knowledge on bioinformatics and chemistry								

Course Objectives:

- To understand the phases of drug development process from bench to bedside
- To study the concept of QSAR and docking.
- To study the bioassay methods, clinical trials and regulatory requirements involved in drug discovery.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the different stages of drug Discovery	K1, K2
CO2	• Working with molecular modeling software to design new drug molecule	K4, K3
CO3	• Design new drug molecules using molecular modeling software	K2, K4
CO4	• Employ bioassay techniques in Biomedical research and Drug Development.	K4
CO5	• Students will understand the design, regulation and ethical aspects of clinical trials including IND and NDA Process.	K1
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	**Introduction to the Drug Discovery:** Early History of Medicine, Drug Discovery and Development in the Middle Ages, Foundation of Current Drug Discovery and Development, Beginnings of Modern Pharmaceutical Industry, Evolution of Drug Products.

Unit II	**Drug Designing**: Introduction, Rational drug design, Computer based drug design, and target based drug design. Target identification, Target Validation, Screening of Hits, Lead Optimization, Molecular Modeling and virtual screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening, Molecular docking, De novo drug design.
Unit III	**Drug Discovery:** Small Molecule Drugs- Irrational Approach, Rational Approach, Antisense Approach, RNA Interference Approach, Chiral Drugs, High -Throughput Screening. "Omics"- Guided Approach – Genomics, Proteomics, Metabolomics. Large Molecule Drugs- Vaccines, Antibodies, Cytokines, Hormones.
Unit IV	**Bioassay:** In Vivo-Based Bioassay- Brine Shrimp Model, Zebrafish Model, Drosophila Model, Animal Models - The Wistar Rat, Immunocompromised Mice, The Nude Mouse, The SCID Mouse, Transgenic Animal Models, Knockout Animal Models. Bioassay in Isolated Organs, Cell-Based Bioassay, Reporter Gene Assay, Enzyme-Based Bioassay, Receptor- Based Bioassay, Immunoassay- Assessment of Immune Function.
Unit V	**Clinical Trials:** Clinical Trials- Types and Design, Investigational New Drug Application, New Drug Application (NDA) Requirements, Ethical Considerations, Regulatory Requirements for Clinical Trials, Role of Regulatory Authorities, Food, Drug, and Cosmetic Act of 1938, Continuing Challenges and Refinements.
Current Contours	**(Not for Final Exam, only for Discussion)** Combinatorial Chemistry: Introduction: Concepts and Terms, Solid-phase Strategies, Solution Phase Strategies, Computer-Aided Drug Design, Docking and virtual screening, Molecular Dynamics and binding free energy methods.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	M
CO2	S	VS	VS	VS	S
CO3	VS	VS	S	S	S
CO4	S	S	VS	M	VS
CO5	VS	S	VS	S	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Robert GCK, ed. (1977). “Drug Action at the Molecular Level” University Prak Press Baltimore.
2. Martin YC. (2010). “Quantitative Drug Design” Dekker, New York.
3. Delgado JN, Remers WA eds “Wilson & Gisvolds. (2004). Text Book of Organic Medicinal & Pharmaceutical Chemistry” Lippincott, New York.
4. Foye WO. (1995). “Principles of Medicinal chemistry „Lea & Febiger.
5. Smith HJ, Williams H, eds. (2005). “Introduction to the principles of Drug Design and Action” WrightBoston.
6. Hinchliffe, Alan John, Wiley-VCH. (2008). Molecular Modelling for Beginners
7. Perun, Thomas J., B. I. Waverly. (1989). Computer-Aided Drug Design. Taylor &Francis
8. Benjamin Blass. (2015). Basic Principles of Drug Discovery and Development, AcademicPress.
9. Rick Ng. (2008). Drugs from Discovery to Approval, 2nd edition
10. Mak KK, Wong YH, Pichika MR. (2023). Artificial intelligence in drug discovery and development. Drug Discovery and Evaluation: Safety and Pharmacokinetic Assays. Sep 28:1-38.
11. Srivani M, Murugappan A, Mala T. (2023). Cognitive computing technological trends and future research directions in healthcare—A systematic literature review. Artificial Intelligence in Medicine. 138:102513.
12. Anthwal A, Uniyal A, Gairolla J, Singh R, Gehlot A, Abbas M, Akram SV. (2024). Industry 4.0 technologies adoption for digital transition in drug discovery and development: a review. Journal of Industrial Information Integration. Jan 10:100562.
13. Murray AJ, Cox LR, Adcock HV, Roberts RA. (2024). Academic drug discovery: Challenges and opportunities. Drug Discovery Today. Feb 14:103918.

Related Online Contents:

1. https://www.frontiersin.org/journals/drug-discovery

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SEMESTER - VIII

LABORATORY COURSE -8: IMMUNE AND MOLECULAR DIAGNOSTICS

Course Code	BM48CP7	Course Type	Laboratory Course	L	T	P	C	Syllabus version	2022-2023
				1	-	4	3		
Pre-requisite	Knowledge on immunology and molecular biology								

Course Objectives:

- To perform test to screen sexually transmitted disease, syphilis, by immune based assay.
- To perform isolation of lymphocytes that could be used for various applications – lymphocyte culture, HLA typing and immunophenotyping.
- To perform DNA isolation and PCR based assays including PCR-RFLP & VNTR analysis

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Perform experiments based on the principle of Antigen-Antibody Interaction (agglutination/precipitation) and interpret results.	K2, K4
CO2	• Perform lymphocyte isolation and separation of T and B lymphocytes manually.	K2, K3
CO3	• Perform extraction of DNA from peripheral blood, amplify gene fragment by PCR.	K2, K3
CO4	• Perform molecular assays based on restriction enzyme digestion (PCR- RFLP).	K2, K4, K7
CO5	• Perform DNA based VNTR- analysis.	K2, K4, K7
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Part I A. Experiment based on the principle of Antigen-Antibody Interaction

1. VDRL Test - Flocculation Test (Precipitation in solution)
2. RPR Test - Agglutination Test
3. CRP Test – Latex Agglutination Test
4. Heamagglutination Assay
5. Ouchterlony Double Diffusion - Antibody titration (Precipitation in Gel - Immunodiffusion)
6. Ouchterlony Double Diffusion – Antigen Antibody pattern

B. Cell based assay

7. Isolation of lymphocytes from peripheral blood by Density gradient centrifugation.
8. Separation of T and B lymphocytes

C. Molecular based assay

9. DNA isolation from peripheral blood- (Salting out Procedure) (SA Miller's Method, 1988)
10. PCR amplification of a gene fragment.
11. PCR- RFLP
12. VNTR- analysis

Part II - Spotters

1. Countercurrent immunoelectrophoresis (Precipitation in agar with an electric field)
2. Complement Fixation
3. Enzyme linked Immunosorbent Assay
4. Radio Immuno Assay
5. Western Blotting
6. Microlymphocytotoxicity – in HLA typing.
7. SSCP
8. Heteroduplexing
9. Reverse transcription
10. Taqman Probe

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	S	VS	VS	VS
CO3	VS	VS	S	S	M
CO4	VS	VS	M	VS	VS
CO5	S	VS	VS	S	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. G P Talwar and S K Gupta. (2019). A Handbook of Practical and Clinical Immunology Volume 1, 2nd edition
2. Ankita Joshi and Prof R S Chauhan. (2022) Immunological Techniques Interpretations Validation and Safety Measures
3. Wilson and Walkers. (2018). Principles and Techniques of Biochemistry and Molecular Biology 8 edition
4. Miller, S., Dykes, D., & Polesky, H. (1988). A simple salting out procedure for extracting DNA from human nucleated cells. *Nucleic Acids Research, 16*, 1215.

Related Online Contents:

1. https://www.bio-techne.com/resources/blogs/isolating-immune-cells-from-peripheral-blood
2. https://www.youtube.com/watch?v=LvCCwLMMcj4

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SEMESTER - IX

CORE COURSE -15: STEM CELL BIOLOGY AND REGENERATIVE MEDICINE

Course Code	BM59C17	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on cell biology, genetics and genetic engineering								

Course Objectives:

- To understand the basics and principles of stem cell technologies
- To generate healthy cells to replace diseased cells
- To educate on various types of stem cells and their properties

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend the basics of stem cell biology.	K1
CO2	• Describe the methods for isolation.	K2
CO3	• Illustrate the properties of stem cells	K2
CO4	• Describe various applications of stem cells.	K3
CO5	• Know the therapeutic strategies using stem cells	K1, K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Introduction to the concept of Stem Cell Biology - definition, classification, sources of stem cells, properties, potency, plasticity, self-renewal and expansion. Maintenance of stem cell culture, sub cloning, spontaneous and controlled division of embryonic stem cells. Stem cell Niches. Stem Cells - Molecular Mechanism - Pathway of Proliferation, Migration and Differentiation.
Unit II	Embryonic (ES) and hematopoietic stem cell (HSC): definition, isolation and clinical application- transgenic and bone marrow transplantation (BMT); BMT for autoimmune diseases. Trophoblast stem cell; Epidermal stem cells.
Unit III	Regenerative medicine and Stem cells: Role of stem cells in regeneration, Stem cell lineage tracing, early development and embryonic stem cells. Stem cells in neurodegenerative and cardiovascular diseases

Unit IV	Cancer stem cells - Role in solid tumors, Control of CSC migration and Invasion, Implication of cancer stem cells for therapy. Cytokines as a survival factor in cancer stem cells; exploiting cancer stem cell differentiation for tumor therapy; Targeting autocrine survival signals in CSCs.
Unit V	Introduction to tissue Engineering - Cells as therapeutic agents, Tissue Organization, Tissue Components, Tissue types, tissue dynamics, Homeostasis in highly prolific tissues and tissue repair. Cell and extracellular matrix interactions - Binding to the ECM, Modifying the ECM, Malfunctions in ECM signaling. Direct Cell- Cell contact- Cell junctions in tissues.
Current Contours	**(Not for Final Exam, only for Discussion)** Ethical implications and National policies governing ES cell research for science and the scientist. Ethical issues associated with stem cell biology.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	VS	M	S
CO3	S	S	VS	S	VS
CO4	VS	VS	S	VS	M
CO5	VS	S	VS	S	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Mummery CL, Van de Stolpe A, Roelen B, Clevers H. (2021). Stem cells: scientific facts and fiction. Academic Press 3rd Edition.
2. Vertes AA, Qureshi N, Caplan AI, Babiss LE, editors. (2015). Stem cells in regenerative medicine: Science, regulation and business strategies. John Wiley & Sons.
3. Bernhard Palsson and Sangeeta Bhatia. (2009). Tissue Engineering, Pearsons;

Related Online Contents:

1. https://sci.amegroups.org/article/view/27241/html
2. https://onlinelibrary.wiley.com/doi/10.1155/2015/734731

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SEMESTER - IX

CORE COURSE -16: CANCER BIOLOGY

Course Code	BM59C18	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Basic Knowledge on Cell Biology, Molecular Biology and Genetics								

Course Objectives:

- To study the hall marks of cancer and cell-cycle deregulation in cancer.
- To understand the molecular mechanism and progression of cancer.
- To learn the advanced diagnostic tools and therapeutic strategies in cancer.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the basic properties of cancer cells and hallmarks of cancer.	K2
CO2	• Analyze that how tumor staging and grading are performed.	K4
CO3	• Describe the cell cycle regulatory mechanism and its significance & impact in cancer therapeutics.	K2
CO4	• Order the steps involved in molecular mechanism of cancer progression & metastasis.	K4
CO5	• Describe an Oncogene, proto oncogenes and function of tumor suppressor genes.	K1, K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Introduction: cancer cell and its properties, Classification of cancer (carcinoma, sarcoma, leukemia, lymphoma), Multistep nature of cancer-Epidemiology of cancer -WHO classification- Tumor staging and grading-Overview of Hallmarks of cancer.

Unit II	Cell growth and cell cycle regulation: Cell cycle (Four discreet phases of cell cycle)- Cell cycle and growth regulation- Major cell cycle regulatory check points (G1& G2/M checkpoint)- Cyclins and Cdks in cell cycle regulation- Mutation causing loss of cell cycle control and induction of cancer- Protein phosphorylation and de phosphorylation control cell cycle regulation.
Unit III	Mechanism: Chemical Carcinogens (initiation, promotion and progression), Radiation and cancer- Free radicals, antioxidants in cancer- Oncogenes (Bcr-Abl1 and ErbB2), Viral oncogene and non-viral (cellular) oncogene, Activation of proto oncogenes (c-myc, Ras superfamily) - Tumor suppressor genes (RB, PTEN, BRCA1, BRCA2 and p53 in cancer) – Familial cancer and Knudson's two hit hypothesis-LOH-NF-kB & Wnt-β signalling pathway in human cancer.
Unit IV	Apoptosis & Metastasis: Bcl2 family proteins, Caspases, Apoptotic signaling pathway (Intrinsic and extrinsic pathway- Telomeres and immortality - Molecular mechanism of tumor metastasis &EMT markers - VEGF &Tumor angiogenesis.
Unit V	Diagnosis and Treatment: NGS based Diagnostic Approaches, Tumor markers & Tumor suppressor genes as diagnostic tool- Strategies for cancer therapy: Chemotherapy & classification of cytotoxic drugs (Alkylating agents, Platinum drugs, Topoisomerase inhibitors, Mitotic inhibitors), Radiotherapy, Gene therapy, Immunotherapy, Monoclonal antibody (dostarlimab) & Stem Cell therapy -Precision cancer medicine.
Current Contours	**(Not for Final Exam, only for Discussion)** India Cancer Research Consortium (ICMR-ICRC), Global Cancer Consortium and its activities- Milestones in cancer research - Artificial intelligence- based therapy design.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	S	VS	VS	S
CO2	VS	VS	VS	S	VS
CO3	VS	VS	VS	VS	S
CO4	VS	VS	S	VS	VS
CO5	S	VS	VS	M	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter. (2014). Molecular Biology of the Cell. 6th Edition. Garland Science.
2. Stella Pelengaris and Michael Khan (2006).The Molecular Biology of Cancer. Wiley–Blackwell.
3. Hanahan D, Weinberg RA. (2011). Hallmarks of cancer: the next generation. Cell. Volume144, Issue 5, 646 – 674.
4. Robert Weinberg (2006). The Biology of Cancer. Garland Science: New York.
5. Robert G. McKinnell, Ralph E. Parchment, Alan O. Perantoni, G. Barry Pierce, Ivan Damjanov (2006). The Biological Basis of Cancer. 2nd Edition. Cambridge University Press.

6. Julio Licinio, Ma–Li Wong (2002). Pharmacogenomics: The Search for Individualized Therapies. 1st Edition. Wiley VCH.
7. Pradeep Kumar (2022). The Textbook of Cancer Biology. Prachi Digital Publication. ISBN-10: 9390910323, ISBN-13: 978-9390910328.
8. Kousik Saravana (2023). Fundamentals of Cancer Biology, Abhayam Book Publisher, ISBN: 978-81-959205-0-1.

Related Online Contents:

1. https://www.tandfonline.com/toc/kcbt20/current
2. https://www.researchgate.net/publication/380782004_CANCER_BIOLOGY_other_name_Molecular_Oncology_-_course_syllabus_-_updated_2024
3. https://www.cambridge.org/in/universitypress/subjects/life-sciences/cell-biology-and-developmental-biology/introduction-cancer-biology-2nd edition?format=PB&isbn=9781009068338
4. https://www.sciencedirect.com/journal/advances-in-cancer-biology-metastasis/about/editorial board

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SEMESTER - IX

CORE CHOICES COURSE -3: MEDICAL GENETICS

Course Code	BM59C19MG	Course Type	Core Choices	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on DNA structure and regulation								

Course Objectives:

- To understand the genetics contributes to predisposition and progression of diseases.
- To know the importance of cytogenetics in assessing genetic impact on diseases.
- To provide an overview on the importance and steps involved in Prenatal Diagnosis and Genetic Counseling.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend the importance of Cytogenetics and banding patterns.	K2
CO2	• Illustrate the genetic abnormalities and syndromes	K1
CO3	• Understand genetic defects associated with common genetic disorders.	K1, K2
CO4	• Equip on the techniques for evaluating genetic diseases.	K2
CO5	• Elucidate the mechanism and patterns underlying disease onset.	K2, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Cytogenetics: International System for human Cytogenetic Nomenclature; Differential and selective banding techniques; High resolution banding; Chromosomal mapping - somatic cell hybridization, FISH technique and its applications; The techniques CGH, array CGH, M-FISH and their applications.
Unit II	Aneuploidy and Structural chromosomal aberrations: Abnormalities of chromosome number - polyploidy, Aneuploidy; Autosomal aneuploidy syndromes - trisomy 21, trisomy 18, trisomy 13; Sex chromosome aneuploidy syndromes - Turner, Klinefelter, triple X, XXY; Factors causing aneuploidy - nondisjunction. Structural chromosomal aberrations in man: duplication, deletion, reciprocal translocation, Robertsonian translocation, ring chromosome, inversion, isochromosome, microdeletion - Cri du-chat syndrome, Wolf-Hirschhorn syndrome, Di-George syndrome; Imprinting phenomenon; Prader- Willi syndrome; Angelman syndrome.

Unit III	Inborn errors - PKU, Alkaptonuria, Homocystinuria, Histidinuria and Albinism. Galactosemia, Diabetes, Hypoglycemia, Lactic acidosis, G-6PD deficiency and glycogen storage disorders. Storage disorders: Mucopolysaccharidoses, Hemoglobinopathies: classification, globin gene mutation, thalassaemias, sickle cell anemia and other hemoglobin variants.
Unit IV	Prenatal diagnosis: chromosomal aberrations and pregnancy loss; Prenatal diagnostic techniques - amniocentesis, chorionic villus sampling, cordocentesis; Noninvasive techniques (Ultrasound, MRI, Maternal Serum Screening for Down's syndrome & Neural tube defect, Fetal Blood Sampling, etc.); Preimplantation genetic diagnosis and in vitro fertilization; Carrier detection;
Unit V	Genetic counselling: Information gathering and construction of pedigrees; Patterns of inheritance, risk assessment and counselling in common Mendelian and multifactor syndromes; Legal and ethical considerations.
Current Contours	**(Not for Final Exam, only for Discussion)** Pedigree drawing for Mendelian and Mitochondrial inheritance, Risk estimation for single gene disorders, Gene frequency estimation for all types of genetic disorders.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	VS	VS	M
CO3	VS	S	VS	S	S
CO4	VS	VS	S	M	VS
CO5	VS	S	VS	VS	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Cohn R, Scherer S, Hamosh A, editors. (2023). Thompson & Thompson Genetics and Genomics in Medicine E-Book: Thompson & Thompson Genetics and Genomics in Medicine E-Book. Elsevier Health Sciences.
2. Turnpenny PD, Ellard S, Cleaver R. (2020). Emery's Elements of Medical Genetics and Genomics: Emery's Elements of Medical Genetics E-Book. Elsevier Health Sciences.
3. Jorde LB, Carey JC, Bamshad MJ. (2019). Medical Genetics E-Book: Medical Genetics E-Book. Elsevier Health Sciences.

Related Online Contents:

1. https://online.duke.edu/course/introduction-genetics-evolution/
2. https://www.hugo-international.org/online-courses/

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SEMESTER - IX

CORE CHOICES COURSE -3: MEDICAL VIROLOGY

Course Code	BM59C19MV	Course Type	Core Choices	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on basic microbiology / clinical microbiology								

Course Objectives:

- To learn the basic properties of virus and associated human diseases.
- To study the mode of viral transmission, replication and host pathogenesis interaction.
- To gain knowledge on the diagnosis, treatment and prevention of viral diseases.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the bacterial viruses with different structures and genomes enter, replicate, assemble and release from the host cell.	K4
CO2	• Gain knowledge on structure and mechanisms related to host pathogen interaction.	K1, K2
CO3	• Comprehend the human RNA viruses of Corona, Ebola and HIV.	K2
CO4	• Understand the Herpes, Varicella-Zoster and Epstein-Barr viruses.	K7
CO5	• Acquire the information on the basis of vaccine and antiviral strategies.	K2, K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Introduction to virology – Discovery of virus – nomenclature – host, nucleic acid and structure. General properties – general methods of diagnosis and serology – Viriods, Prions, Satellite RNAs and Virusiods.
Unit II	Replication of viruses – OX 174, M13, Mu, T4, Lamda and P1; Structural organisation – life cycle, Transcription, DNA replication and phage production, Lysogenic and lytic cycle – typing and application in bacterial genetics.

Unit III	Human viruses I – Epidemiology, transmission, pathogenesis, diagnosis, prevention, treatment. RNA viruses – Picorna, orthomyxo, paramyxo, toga and other arthropod viruses. Corona virus, Rabies, Lujo, H5N1 virus, Measles, Mumps, Dengue viruses, Ebola, Rhabdo, Rota, HIV, Oncogenic virus.
Unit IV	Human viruses II – Epidemiology, transmission, pathogenesis, diagnosis, prevention, treatment. DNA viruses - Pox, Papilloma, Herpes, Adeno, Parvo Hepadna and Hepatitis. Varicella-Zoster virus, Cytomegalovirus, Epstein–Barr virus.
Unit V	Diagnostic virology - Basic virological methods, Overview of diagnostic methods, serological methods. Commonly used diagnostic methods for individual methods. Basics of viral entry, spread and transmission. Host resistance to viral infection: Immune responses, Vaccines and antiviral chemotherapy: the prevention and treatment of viral diseases.
Current Contours	**(Not for Final Exam, only for Discussion)** Molecular Genetics of Viruses: Viral genome-Locating sites of restriction Endonuclease cleavage on the viral genome-restriction mapping-cloning fragments of viral genomes using bacterial plasmids-Genetic manipulation of viral genomes-Mutations in genes and resulting changes to proteins- Analysis of mutation-Complementation-Recombination-Isolation of mutants.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	VS
CO2	VS	S	S	VS	M
CO3	VS	VS	VS	S	VS
CO4	S	VS	VS	M	S
CO5	VS	S	S	VS	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. David Greenwood, Richard C.B Stack. John Forest Peucture. (1992). Medical Microbiology, 14th edition.
2. Peter M. Howley MD, David M. Knipe, Lynn W. Enquist. (2023). Fields Virology: Fundamentals Seventh Edition, ISBN-10: 1975112512, ISBN-13 :978-1975112516.
3. Dr Chand Pasha, Dr Vimala Rodhe. (2024). Bacteriology and Virology Perfect Paperback ISBN:978-93-95854-97-9, Professional Books Publishers.
4. Phoebe Lostroh. (2024). Molecular and Cellular Biology of Viruses 2nd Edition by ISBN-10 :1032732105, ISBN-13: 978-1032732107.

Related Online Contents:

1. https://www.nature.com/subjects/virology
2. https://virologyj.biomedcentral.com/articles
3. https://onlinelibrary.wiley.com/journal/10991654
4. https://www.sciencedirect.com/journal/journal-of-clinical-virology

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SEMESTER - IX

ELECTIVE COURSE-3: SCIENTIFIC WRITING AND COMMUNICATION

Course Code	BM59E3SC	Course Type	Elective	L	T	P	C	Syllabus version	2022-2023
				4	1	-	4		
Pre-requisite	Basic knowledge on general science								

Course Objectives:

• To educate the students in improving their ability to comprehend and utilize various scientific information /resources.
• To train students to create original literature while avoiding plagiarism.
• To enable students to plan and write various types of academic assignments

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Explain and use strategies of scientific writing for a report	K1
CO2	• Prepare and deliver an oral presentation that clearly explains a subject within the own field to a broad audience	K2
CO3	• Decide on the type of graphical presentation, suits the results from different types of data	K4
CO4	• Use a range of digital tools to efficiently produce documents in correct in English	K1
CO5	• Critically review the scientific texts written by others, for constructive criticism on contents, vocabulary and text structure	K1, K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	**Foundations of Scientific Communication** Evolution of Scientific Communication, Types of Scientific Publications (Original Research Articles, Review Articles, Short Communications, Case Reports, Systematic Reviews and Meta-Analyses, Conference Proceedings), Scientific Publishing Ecosystem (Subscription Journals, Open Access Journals, Hybrid Journals, Preprint Servers), Literature Search Strategies (PubMed, Scopus, Web of Science, Google Scholar), Research Question Development, Hypothesis Formulation, Identifying Research Gaps

Unit II	**Scientific Writing and Manuscript Preparation** Principles of Effective Scientific Writing, Scientific Style and Language, Structure of Research Articles (IMRAD Format), Title, Abstract and Keywords, Introduction and Literature Review, Materials and Methods, Results and Data Presentation, Discussion and Conclusion, Writing Review Articles, Preparing Tables, Figures and Infographics. Use of AI Tools in Scientific Writing: ChatGPT, Grammarly, Elicit, Consensus. Limitations and Ethical Use of AI
Unit III	**Publication Process and Research Metrics** Selecting Appropriate Journals, Predatory Journals and Publishers, Manuscript Submission Systems, Peer Review Process, Responding to Reviewer Comments, Acceptance and Production Process, Research Visibility and Dissemination, Bibliometrics and Scientometrics: Impact Factor, CiteScore, h-index, i10-index, Altmetrics. Researcher Profiles: ORCID, Google Scholar Profile, Scopus Author ID, ResearchGate.
Unit IV	**Research Ethics, Integrity and Open Science** Research Integrity, Plagiarism and Self-Plagiarism, Fabrication, Falsification and Misconduct, Authorship Ethics, Conflict of Interest, Copyright and Licensing, Human and Animal Research Ethics, Institutional Ethics Committee (IEC/IRB), Clinical Trial Registration, Data Sharing and Reproducibility, FAIR Data Principles, Open Science Practices, Similarity Detection Tools: Turnitin, iThenticate, Viper.
Unit V	**Advanced Research Communication** Citation Styles: APA, Vancouver, Harvard. Reference Management: Zotero, EndNote, Mendeley. Grant Proposal Writing, Project Report Writing, Thesis and Dissertation Writing, Scientific Poster Preparation, Oral Presentation Skills, Science Communication for Public Audiences, Research Data Visualization, Academic Networking and Collaboration, Research Communication through Social Media

Current Contours	**(Not for Final Exam, only for Discussion)** How to Write a Grant Proposal: An Overview of the Grant Proposal Process Funding Agencies Grants and Contracts Offices, Types of Grant Proposals Research Grant Proposals Service Delivery Grant Proposals Grants to Individuals. Developing A Grant Proposal Evaluating Your Idea Writing a Concept Paper Finding a Potential Funding Source How to Read Guidelines and Program Announcements Writing the Proposal Organizing research proposals Organizing service delivery proposals Preparing the Budget Submitting the Proposal Characteristics of Successful and Unsuccessful Proposals Industry-Sponsored Research

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	S	VS	S	S	S
CO3	VS	VS	VS	VS	VS
CO4	VS	VS	VS	S	M
CO5	VS	S	S	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Wager E. (2015). Getting research published: An A to Z of publication strategy. Radcliffe Publishing Ltd, Third Edition.
2. Hall GM (ed). (2012). How to write a paper. Fifth edition. BMJ Publishing Group, Wiley – Blackwell.
3. Byrne D. W. (2009). Publishing your medical research. Wolters Kluwer, Baltimore, US, 2017.
4. Fraser J., Fuller L. & Hutber G. Creating. (2009). Effective Conference Abstracts and Posters in Biomedicine. Radcliffe Publishing, UK.
5. Lang, T. (2009). How to Write, Publish, & Present In The Health Sciences (PDF): A Guide for Clinicians and Laboratory Researchers. Philadelphia, PA: American College of Physicians.
6. Sun Z, He D, Li Y. (2024). How the readability of manuscript before journal submission advantages peer review process: Evidence from biomedical scientific publications. Journal of Informetrics.18(3):101547.
7. Elsman EB, Mokkink LB, Terwee CB, Beaton D, Gagnier JJ, Tricco AC, Baba A, Butcher NJ, Smith M, Hofstetter C, Aiyegbusi OL. (2024). Guideline for reporting systematic reviews of outcome measurement instruments (OMIs): PRISMA-COSMIN for OMIs 2024. Journal of Clinical Epidemiology.
8. Bojcic R, Todoric M, Puljak L. (2024). Most systematic reviews reporting adherence to AMSTAR 2 had critically low methodological quality: a cross-sectional meta-research study. Journal of Clinical Epidemiology. 165: 111210.

Related Online Contents:

1. https://chem.duke.edu/undergraduate/internet-sources-scientific-writing
2. https://www.augusta.edu/cwe/stem-writing-services.php
3. https://global.oup.com/ushe/product/scientific-writing-and-communication-9780197613795?cc=in&lang=en&

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SEMESTER - IX

ELECTIVE COURSE-3: RESEARCH METHODOLOGY AND BIOSTATISTICS

Course Code	BM59E3RM	Course Type	Elective	L	T	P	C	Syllabus version	2022-2023
				4	1	-	4		
Pre-requisite	Basic knowledge on statistics								

Course Objectives:

• To understand the rationale and logic of conducting a research work.
• To understand research design approaches to be adopted, principles of sampling methods and methodology to be employed.
• To understand the methods for analysis, presentation and preparation of reports.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Definition of "research" and understanding the various steps to do research.	K2
CO2	• Explains about different types of research based objectives.	K1
CO3	• Explain the different types of research methodologies.	K1, K2
CO4	• Describes the research problem and types of hypothesis.	K1
CO5	• Explains about sample designs and types of sampling.	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Meaning of research – Objectives of research – Types of research – Pure, applied, historical, analytical, descriptive and experimental – Significance of research – Research methods versus methodology – Scientific and research methods – Induction and Deduction – Research process.
Unit II	Planning Research – Defining research problem – Identification, selection and Formulation of research problem – Review of literature – Hypothesis – Meaning, sources of hypotheses – Types of hypothesis – Formulation and testing – Research design – Meaning, need, features of a good design – Basic principles of experimental design – Factors affecting research design – Evaluation of research design.
Unit III	Sampling Design – Census method and sampling method for investigation – advantages and disadvantages of sampling – Principle of sampling – Essentials of good sampling – Methods of sampling – Probability and Non-probability sampling methods – Random sample – Factors affecting sample size – Sampling and non sampling errors.

Unit IV	Methods of Data collection – Primary and Secondary data – Modes of data collection – Analytical method – case study – observation method – interview method – Questionnaries in data collection – Collection of data through schedules – Advantages and limitations – Pre-testing and its importance.
Unit V	Processing and analysis of data – Types of analysis – Statistics in research – Editing, Coding, Tabulation and Diagrams – Process of interpretation – Guidelines for making valid interpretations – Report writing – Roles and types of reports – Contents of research reports – Steps involved in drafting reports – Referencing.
Current Contours	**(Not for Final Exam, only for Discussion)** Understanding market research before launching of any consumer products, understanding success stories of clinical trials before lanching of drugs in market.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	S	VS	M	VS
CO2	VS	VS	S	VS	VS
CO3	VS	VS	VS	VS	VS
CO4	VS	S	M	S	S
CO5	VS	VS	S	VS	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. C.R. Kothari. (2004). Research Methodology – Methods and Techniques (2nd Edition.)
2. Ranjit Kumar. (2011). Research Methodology (Third Edition).
3. Verma R, Verma S, Abhishek K. (2024). Research methodology. Booksclinic Publishing.

Related Online Contents:

1. https://usiu-ke.libguides.com/c.php?g=942913&p=6796759
2. https://www.quora.com/What-is-the-best-online-resources-to-study-biostatistics
3. https://health.usf.edu/research/rmbc
4. https://books.google.co.in/books/about/Research_Methodology_and_Biostatistics_E.html?id=ddc6EAAAQBAJ&redir_esc=y

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SEMESTER – IX

LABORATORY COURSE -9: CELL CULTURE TECHNIQUES

Course Code	BM59CP8	Course Type	Laboratory Course	L	T	P	C	Syllabus version	2022-2023
				1	-	4	3		
Pre-requisite	Basic knowledge on cell biology and lab exposure								

Course Objectives:

- To provide hands on training on basics of cell culture
- To equip students on handling cells, monitoring cytotoxicity or cell death.
- To develop skills on maintaining primary cells and preparing karyotype.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Maintain cells from primary isolates and cell lines.	K1, K2
CO2	• Assess cytotoxicity of the compounds	K1
CO3	• Develop skills for the preparation of chromosomes and identification.	K3
CO4	• Assess the genotoxicity	K2
CO5	• Perform cytotoxic evaluation techniques.	K7
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

List of Practical:

1. Basic cell culture
   a. Media preparation,
   b. culturing,
   c. cryopreservation
2. Sub-culturing and maintenance
3. Cytotoxicity assays and morphological assessment
   a) MTT,
   b) Acridine orange/EtBr
   c) Hoechst33258)
4. Human lymphocyte culture
5. Preparation of Chromosomes and Karyotyping
6. Tissue Engineering

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	S	S	VS
CO2	VS	VS	VS	VS	S
CO3	VS	S	S	VS	M
CO4	S	VS	VS	VS	VS
CO5	VS	VS	VS	M	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Ramkumar KM, Senthilkumar R, Md Enamul Hoque. Editors. (2024). Advanced Mammalian Cell Culture Techniques Principles and Practices. CRC Press.
2. Harrison MA, Rae IF. (1997). General techniques of cell culture. Cambridge University Press;

Related Online Contents:

1. https://www.vanderbilt.edu/viibre/CellCultureBasicsEU.pdf

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SEMESTER - X

CORE COURSE -17: NANOMEDICINE

Course Code	BM510C20	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on chemistry of materials and basic biology								

Course Objectives:

- To acquire knowledge on nanomaterials and its applications in the field of medicine.
- To understand the treatment strategies for human diseases, through nanotherapeutics.
- To educate the methods of drug delivery to the targets using nanoparticles.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Comprehend the importance of Nanostructures.	K1
CO2	• Describe various methods of synthesizing Nanostuctures.	K2
CO3	• Illustrate the chemical, physical and biological properties of nanomaterials.	K1, K4
CO4	• Describe various methods of characterizing nanomaterials.	K5
CO5	• Know the advantages and disadvantages of nanoparticles.	K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Introduction to Nanotechnology, Nano-scaling, Various Structures and synthesis of Nanomaterials: Top-down (Nanolithography, CVD), Bottom-up (Sol-gel processing, chemical synthesis). Wet deposition techniques. Properties of nanoscale materials (optical, electronic and magnetic). Rationale for designing of nanomedicines.
Unit II	Materials for preparation of nanomedicines. Metallic and Semiconductor Nanomaterials, Quantum Dots, Nano wires, Nano-clusters, Bucky balls and Carbon Nanotubes. Nanosystems- Liposomes and Polymeric micelles, Dendrimers, Vesicles.

Unit III	Characterization of Nanomaterials, Spectroscopic techniques – UV visible and infrared spectroscopy, Raman spectroscopy, X-ray diffraction, Microscopy - SEM, TEM, AFM, etc. Characteristics and Biocompatibility of nanoparticles,
Unit IV	Basics of drug delivery, Types - polymer, lipid, metal-based drug delivery system and miscellaneous. Targeted delivery- Active and passive targeting - Enhanced permeability and retention effect, multifunctional property of nanoparticles. Nanocarriers for gene delivery applications. Nanorobots
Unit V	Nanoparticle applications in imaging and diagnostics. Dendrimers as a Multi-functional carrier.Role of Nanomedicine in cell repair and tissue engineering. Nanomedicine against infectious organism, Nanotechnology in drug resistance. Future applications of Nanomedicine. Limitations of nanotechnology. Social and ethical issues, environmental concerns and potential toxicity.
Current Contours	**(Not for Final Exam, only for Discussion)** Clinical translation of nanomedicines: Preclinical and clinical considerations of nanomedicines, Overview of current clinical nanomedicines, Regulations of nanomedicines for human health.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	S	VS	M
CO3	VS	S	VS	M	VS
CO4	S	VS	M	VS	VS
CO5	VS	S	VS	S	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Visakh PM, editor. (2023). Nanomaterials and Nanotechnology in Medicine. Wiley.
2. Webster TJ, editor. (2023). Nanomedicine: Technologies and applications. Woodhead Publishing.

Related Online Contents:

1. Nanomedicine and drug delivery: a mini review https://link.springer.com/article/10.1007/s40089-014-0094-7
2. Nanomedicine: Principles, Properties, and Regulatory Issues https://www.frontiersin.org/journals/chemistry/articles/10.3389/fchem.2018.00360/full

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SEMESTER - X

CORE COURSE 18: BIOSAFETY, BIOETHICS AND IPR

Course Code	BM510C21	Course Type	Core	L	T	P	C	Syllabus version	2022-2023
				4	1	-	5		
Pre-requisite	Knowledge on the field of laboratory techniques and biotechnology								

Course Objectives:

- To introduce the various aspects of Biosafety and Bioethics in laboratory.
- To understand good manufacturing Practice (GMP) and Good lab practices (GLP).
- To learn about Intellectual Property Rights and its importance.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the basic concepts in the laboratory biosafety.	K1, K2
CO2	• Analyze the basic principles of bioethics and its importance in animal experiments.	K4
CO3	• Gain knowledge on biosafety regulations and bioethics	K1
CO4	• Apply the biosafety issues in clinical trials and medical research	K1
CO5	• Understand different types of intellectual property rights in biotechnological processes and products.	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	**Biosafety:** Introduction - Laboratory associated infections and other hazards, Introduction to Biological Safety Cabinets-Assessment of biological hazards and Biological Containment- Good manufacturing Practice and Good lab practices (GMP and GLP).

Unit II	**Bioethics**: Principles of bioethics- Social and cultural issues of Bioethics- Animal ethics; Guidelines for use of lab animals - Licensing of animal house -IAEC & CPCSEA- Ethical concerns of gene cloning- Ethical clearance norms for conducting studies on human subjects, NECRBHR, ICMR- Ethical implications of human genome project-Ethical issues in Human Cloning and stem cell research –Biopiracy
Unit III	**Regulatory framework of Biosafety:** Biosafety guidelines and regulations (National and International) for rDNA and other biological researches -RCGM, RDAC, GEAC, IBSC, SBCC & DLC, IBSC- Definition of GMOs & LMOs - GM Labeling - Ecological safety assessment of GMO‟s (Eg. Bt cotton) and mixing up with the gene-pool- Bioterrorism and convention on biological weapons- Cartagena protocol.
Unit IV	**Pharma and Medical Sector:** Biosafety assessment of pharmaceutical products such as drugs/vaccines etc. Biosafety issues in Clinical Trials. Ethical concerns related to prenatal diagnosis, Gene therapy, Organ transplantation, Xenotransplantation, Ethics in patient care, Informed consent.
Unit V	**Intellectual Property Right (IPR):** Introduction- Different forms of IPR - Overview of WTO, WIPO, GATT & TRIPs- **Patents:** Basis of Patentable and non patentables- Patent Application Procedure in India, PCT- Other Forms of IPR: Trade Mark - Designs-Copyrights, Geographical Indications, Trade secrets, Non-disclosure agreements- Patent Life and Geographical Boundaries -Country-wise patent searches (USPTO, EPO, India etc.)-Traditional Medicine & IP Protection- Treaties and Conventions of Patents.
Current Contours	**(Not for Final Exam, only for Discussion)** Advances in Synthetic Biology and Biosafety Governance-Indian Patent Act 1970 and Patent (Amendments) Act (2002), Protocols in exchanging Biological material across borders, Food Safety and Standards Authority of India (FSSAI), IP as a factor in R&D-Protection of environment and biodiversity-OECD consensus documents and Codex Alimentarius.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	VS	VS	VS	VS
CO2	VS	S	S	M	VS
CO3	VS	VS	M	S	VS
CO4	S	VS	VS	S	S
CO5	VS	VS	VS	S	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Singh K. (1993). Intellectual Property Rights on Biotechnology, BCII, New Delhi.
2. Sateesh MK. (2010). Bioethics and Biosafety, I. K. International Pvt Ltd.
3. Sree Krishna V. (2007). Bioethics and Biosafety in Biotechnology, New age international publishers
4. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and Safety Assessment (3rd Ed). Academic Press.
5. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. New Delhi: Tata McGraw-Hill Pub
6. Fleming, D.A., Hunt, D.L. (2000). Biological safety Principles and practices (3rd Ed).ASM Press, Washington.
7. Recombinant DNA Safety Guidelines, (1990). Department of Biotechnology, Ministry of Science and Technology, Govt. of India. Retrieved from http://www.envfor.nic.in/ divisions/csurv/geac/annex-5.pdf

Related Online Contents:

1. GOI's Patents Website: patinfo.nic.in
2. Intellectual property India: www.ipindia.nic.in
3. USPTO Web Patent Databases at: www.uspto.gov/patft.

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SEMESTER - X

Entrepreneurship / Industry Based Course: Entrepreneurship in Biomedical Science

Course Code	BM510EIB1	Course Type	Entrepreneurship / Industry Based	L	T	P	C	Syllabus version	2022-2023
				4	1	-	4		
Pre-requisite	Knowledge on the field of biomedical science and bio-techniques								

Course Objectives:

• To educate students with the knowledge and skills necessary to translate biomedical innovations into successful ventures.
• To cover the topics in identifying opportunities, developing business models, securing funding, navigating regulatory pathways.
• To equip students through lectures, case studies, guest speakers, and hands-on exercises to develop biomedical startups.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the principles and processes of entrepreneurship in the biomedical sciences and to identify opportunities for innovation and commercialization in biomedicalresearch.	K1, K2
CO2	• Develop skills in business planning, market analysis, and intellectual property management and to learn about funding sources, investment strategies, and venture capital in the biomedical sector.	K3, K4
CO3	• Explore regulatory pathways and compliance requirements for biomedical products and services.	K2
CO4	• Analyze case studies of successful biomedical startups and entrepreneurial ventures.	K4
CO5	• Develop a business plan or pitch presentation for a biomedical startup concept.	K2
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Introduction to Entrepreneurship in Biomedical Sciences, Overview of the entrepreneurial ecosystem, Role of entrepreneurship in translating biomedical research into products and services, Introduction to business model canvas and lean start up methodology. Identifying Opportunities in Biomedical Innovation, Trends and opportunities in biomedical research and healthcare, Needs assessment and market analysis, Identifying unmet clinical needs and customer pain points.

Unit II	Business Planning and Strategy Development, Business model development and validation, Strategic planning and competitive analysis, Value proposition design and customer segmentation. Intellectual Property Management and Technology Transfer, Basics of intellectual property (IP) protection, Patenting process and strategies for IP management, Licensing agreements and technology transfer in academia-industry partnerships.
Unit III	Funding and Financing in Biomedical Entrepreneurship, Sources of funding for biomedical startups (grants, angel investors, venture capital), Pitching and fundraising strategies, Financial modeling and valuation techniques. Regulatory Affairs and Compliance in Biomedical Ventures, Overview of regulatory pathways for medical devices, diagnostics, and therapeutics, Compliance with FDA regulations and other regulatory agencies, Quality management systems and Good Manufacturing Practices (GMP).
Unit IV	Case Studies of Successful Biomedical Startups, Analysis of successful entrepreneurial ventures in biotechnology, medical devices, and digital health, Lessons learned from real-world examples of biomedical innovation and commercialization
Unit V	Developing a Business Plan and Pitch Presentation, Components of a business plan (executive summary, market analysis, financial projections, etc.), Pitch deck essentials and effective communication strategies, Peer review and feedback on business plan presentations
Current Contours	**(Not for Final Exam, only for Discussion)** The Role of AI in Biomedical Startups- The Impact of Biotech Incubators on Biomedical Innovation- Ethical Challenges in Biomedical Entrepreneurship- Intellectual Property in Biomedical Startups- Sustainable Business Models in Biomedical Science- The Role of Crowdfunding in Biomedical Ventures.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	VS	VS	VS	M
CO3	VS	VS	M	M	VS
CO4	VS	S	S	S	S
CO5	VS	VS	VS	S	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Mellor, R. (2008). Entrepreneurship for everyone: A student textbook. Entrepreneurship for Everyone, pp.1-256.
2. Park SM, Vonortas NS. (2024). Biomedical entrepreneurship in US regions. The Journal of Technology Transfer. 49(2):782-800.
3. Gonçalves Leonel da Silva R. (2024). The role of autonomous experimentation in biomedical sciences and health innovation: Challenges and opportunities in emerging economies. The role of autonomous experimentation in biomedical sciences and health innovation: Challenges and opportunities in emerging economies.

Related Online Contents:

1. https://pmc.ncbi.nlm.nih.gov/articles/PMC10122420/
2. https://www.udemy.com/course/entrepreneurship-and-business-research-in-biomedical/?couponCode=MTST7102224B2
3. https://med.nyu.edu/research/technology-opportunities-ventures/sites/default/files/biomedical-entrepreneurship-program-fall-course.pdf

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ODD SEMESTER

VALUE ADDED COURSE 1: PRINCIPLES OF NUTRITION

Course Code	BM47VAC1	Course Type	Value Added	L	T	P	C	Syllabus version	2022-2023
				1	1	-	2		
Pre-requisite	Knowledge on basic biology and nutrition								

Course Objectives:

- To provide knowledge on the nutritional value of food.
- To create awareness and importance of the balanced diet.
- To impart the facts of total energy requirement of body.

Expected Course Outcomes:
On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Know the importance of balanced diet and total energy requirement of body for living a healthy life.	K2, K4
CO2	• Understand the facts of variation in the recommended dietary allowances (RDA) based on the life style, height and weight of the individual.	K2, K7
CO3	• Gain knowledge on basal metabolic rate and its clinical relevance.	K1, K2
CO4	• Comprehend the nutritional requirements recommended by ICMR for different stages of life (Infancy, Childhood, Adolescence, Pregnancy, Lactation and Geriatric nutrition).	K2, K4, K5
CO5	• Understand the facts about energy value of food and the effects of drug therapy on nutrients.	K2, K7
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	**Food groups and Balanced Diet:** Nutritional classification of foods-Energy yielding, Body building and protective food. Functions of food, food pyramid. Balanced diet – Nutrients - Nutritional status- Health.
Unit II	**Nutritional recommendation and requirements:** Recommended dietary allowances (RDA): Definition, Factors affecting RDA. Healthy adults-Reference Indian Men and Woman. Normal Food and Nutritional requirements (ICMR) during Infancy, Childhood, Adolescence, Pregnancy, Lactation and Geriatric nutrition.
Unit III	**Energy Metabolism:** Total energy requirement of body. Energy Value of Food: Definitions, Energy units, Thermic effect of food- carbohydrate, protein and fat. Determination of energy value of foods by direct and indirect calorimetry.
Unit IV	**BMR:** Definitions, Determinations, Factors affecting the BMR; Energy requirements for physical activity – Factorial method, Energy requirement and sources. Changes in basal metabolism and its clinical relevance.

Unit V	**Nutrient and drug Interactions:** Effect of drug therapy on food intake, absorption and utilization of nutrients.
Current Contours	**(Not for Final Exam, only for Discussion)** Observe and note down the energy value of the food mentioned in the refill pack of different types of snacks. Compare the energy values and share your inference.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	VS	VS
CO2	VS	S	VS	VS	M
CO3	VS	VS	VS	S	VS
CO4	S	VS	VS	M	VS
CO5	VS	S	M	VS	S
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Patricia Trueman. (2007). Nutritional Biochemistry, MJP Publications
2. Ambika Shanmugam. (2016). Fundamental of Biochemistry for Medical Students
3. Michael J. Gibney, Marinos Elia. (2006). Clinical Nutrition- edited, Blackwell Publishing

Related Online Contents:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=20802
2. http://ninindia.org/DietaryGuidelinesforNINwebsite.pdf
3. http://dme.ap.nic.in/vt/Health_Topics/Dietary%20guidelines%20for%20Indians.pdf

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ODD SEMESTER

VALUE ADDED COURSE-2: HEALTH AND HOSPITAL MANAGEMENT

Course Code	BM47VAC2	Course Type	Value Added	L	T	P	C	Syllabus version	2022-2023
				1	1	-	2		
Pre-requisite	Basic knowledge on function and support services of a hospital								

Course Objectives:

- To educate the students on various clinical services.
- To understand that the hospital as an organization and its role in healthcare.
- To impart the knowledge on the delivery of hospital services.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand health, disease, and well-being, including determinants and dimensions.	K1
CO2	• Manage outpatient, inpatient, emergency, OT, and ICU services, with quality and infection control.	K3, K7
CO3	• Manage diagnostic and support services, including labs, housekeeping and pharmacy.	K1, K2
CO4	• Infection Control & Waste Management: Implement infection control and biomedical waste management practices.	K3
CO5	• Adapt to and implement new developments in hospital administration.	K1
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Disease and Wellbeing, Concept of Health and Hospital: Definition of health, disease and wellbeing. Dimensions & determinants of health. Evolution of hospital services: Indian & Global Scenario, Concept of Modern Hospital & Privatization in Health Sector, Changing Role of Hospitals in a Globalized Society -Types of Hospital -Hospital as a complex organization. Management structure of a Hospital -Duties, functions & responsibility of a hospital administrator.
Unit II	Management of Clinical Services: Out Patient services, Inpatient, Accident & Emergency Clinical Services, Operation Theatre & ICU Location, layout and functions – Types of OT. Quality Control measures and record keeping. Infection control measures.
Unit II	Management of Diagnostic and Support Services: Conventional Laboratory services, Linen & laundry services, CSSD services, Housekeeping services, Infection control in hospital, Dietary & nutrition services in hospital, Pharmacy services, Ambulance Services, Blood bank – location, layout and functions – Examining Donors. Bleeding technique, matching, cross matching / blood bank names.
Unit IV	Hospital Infection Control & Bio Medical Waste Management: Organizational structure of infection control – Hospital infection control committee, infection control ream, infection control manual, role of physicians, role of microbiologists, role of nursing staff. Biomedical Waste Management: Introduction, types & composition of biomedical wastes.
Unit V	Newer Developments in Hospital Administration: Telemedicine: scope, objective & functions, Classification, Global Scenario, Indian Scenario, Challenges. Electronic medical record system, EMR access & updation. Medical Tourism: Introduction, Health & Medical tourism, Efforts and features of the hospitals to facilitate medical tourism - Implications of medical tourism.
Current Contours	**(Not for Final Exam, only for Discussion)** Introduction of Hospital Management- Supplementary classification of factors influencing health status and contact with health service.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	VS
CO2	S	VS	S	S	S
CO3	VS	VS	M	S	VS
CO4	VS	VS	VS	M	S
CO5	VS	VS	S	VS	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Kumar. R & S.L. Goel. (2004). Hospital Administration in 21st Century Hospital Core Services, Deep and Deep Publications.
2. Sakharkar. B. M. (2009). Principles of Hospital Administration Planning: Jaypee Brothers Publishers.
3. Srinivasan. A.V. (2008). Managing a Modern Hospital- Sage Publication.
4. Tabish Syed Amin. (2001). Hospital and Health Services Administration: Principles and Practice, OUP India
5. Kunders G. (2017). Hospitals - Facilities Planning & Management - Facilities Planning and Management, McGraw Hill Education
6. K. Shridhara Bhat. (2017). Total Quality Management: Text & Cases, Himalaya Publishing House
7. Francis Cm. (2004). Hospital Administration, Jaypee Brothers Publishers
8. Steven F. Larson. (2013). Medical Tourism: Adventures in India

Related Online Contents:

1. https://www.tandfonline.com/toc/yjhm20/17/3
2. https://intjem.biomedcentral.com/articles
3. https://www.tandfonline.com/toc/dijg20/2024

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EVEN SEMESTER

VALUE ADDED COURSE -3: NUTRITIONAL BIOCHEMISTRY

Course Code	BM48VAC3	Course Type	Skill Based Elective	L	T	P	C	Syllabus version	2022-2023
				1	3	-	2		
Pre-requisite	A basic biochemistry and knowledge on essential nutrition								

Course Objectives:

- To gain knowledge on critical nutrients of diet.
- To study the types and properties of macro and micronutrients in food.
- To understand the importance of human nutrition.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Define nutrition and essential nutrients.	K1
CO2	• Comprehend the essential functions of biological macro and micronutrients.	K1, K2
CO3	• Summarize the metabolic process of nutrients in human cells and tissues.	K3
CO4	• Explain the importance of balanced diet and health.	K2, K3
CO5	• Describe nutrient deficiencies and its association with common metabolic disorders.	K3, K4
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Dietary Carbohydrates and Functions**:** Definition, nutritional classification, sources and biological functions. Recommended dietary allowance (RDA) of carbohydrates for adults Regulation of blood sugar level.
Unit II	Dietary Proteins and Functions: Definition, nutritional classification, sources and biological functions. RDA of protein for adults. Protein malnutrition. Methods of measuring protein quality - protein efficiency ratio (PER), biological value of protein (BV) and net protein utilization (NPU).
Unit III	Dietary Lipids and Functions: Definition, nutritional classification, sources and biological functions. Recommended fat intake for adults. Essential fatty acids –Definition, sources and biological importance.
Unit IV	Micronutrients and Biological Importance: Vitamins – Definition, types, their functions and sources. Fat soluble vitamins: A, D, E and K and water-soluble vitamins: B-Complex and vitamin C.
Unit V	Minerals and Importance: Classification and General Functions. Macro and Microminerals-Functions, Requirements, Sources, Effects of deficiency, Effect of imbalance (Sodium and Potassium). Dietary Fiber: Definition,

	Classification, Sources and its role in human health.
Current Contours	**(Not for Final Exam, only for Discussion)** Role of natural products as energy supplements, Nutritional strategies for metabolic syndrome. Nutritional challenges in adolescence.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	VS	VS
CO2	VS	S	M	S	S
CO3	VS	VS	S	M	VS
CO4	S	S	VS	S	S
CO5	S	VS	VS	VS	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Swaminathan, M. (2014). *Handbook of Food and Nutrition*, (5th ed.). The Bangalore Printers and Publishing Company.
2. Tom Brody. (1998). *Nutritional Biochemistry*, (2nd ed.). Academic Press, USA.
3. Garrow, J.S., James, W.P.T., & Ralph, A. (2000). *Human Nutrition and Dietetics*, (10th ed.). Churchill Livingstone Press, London.

Related Online Contents:

1. https://doi.org/10.3390/ijerph19116526
2. https://www.ncbi.nlm.nih.gov/books/NBK218764/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6020734/
4. https://open.maricopa.edu/nutritionessentials/chapter/essential-nutrients/

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EVEN SEMESTER

VALUE ADDED COURSE 4: CLINICAL DATA ANALYSIS

Course Code	BM48VAC4	Course Type	Value Added	L	T	P	C	Syllabus version	2022-2023
				1	1	-	2		
Pre-requisite	Basic knowledge on statistics and research methodology								

Course Objectives:

- To provide a comprehensive understanding of clinical data analysis.
- To educate on different aspects of clinical data, including collection, management, statistical analysis, interpretation, and presentation.
- To equip students with the skills necessary to analyze and interpret clinical data effectively.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Identify various types of clinical data and their sources.	K1, K2
CO2	• Apply data cleaning and preprocessing techniques to handle missing and inconsistent data.	K3
CO3	• Explain the importance and applications of clinical data in biomedical research.	K4
CO4	• Implement machine learning algorithms for predictive modelling and risk assessment.	K3, K6
CO5	• Adhere to best practices in reporting clinical data findings.	K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	**Introduction to Clinical Data-** Overview of clinical data and its importance in biomedical research- Types of clinical data: qualitative vs. Quantitative - Sources of clinical data: electronic health records (EHR), clinical trials, and public health databases - Data privacy, security, and ethical considerations - Data collection methods and tools.

Unit II	**Data Management and Preprocessing** - Data cleaning and preprocessing - Handling missing data - Data normalization and standardization - Database management systems - Data integration and interoperability
Unit III	**Statistical Analysis of Clinical Data-** Descriptive statistics - Inferential statistics: hypothesis testing, confidence intervals, p-values - Regression analysis - Survival analysis - Statistical software for clinical data analysis (R, SAS, SPSS)
Unit IV	**Advanced Data Analysis Techniques** - Machine learning and its applications in clinical data - Predictive modeling and risk assessment- Cluster analysis and classification techniques - Data visualization and interpretation - Advanced software tools (Python, MATLAB)
Unit V	**Reporting and Presenting Clinical Data** - Best practices for clinical data reporting - Creating effective charts, graphs, and tables - Writing scientific reports and papers - Presentation skills for biomedical data- Regulatory requirements and standards.
Current Contours	**(Not for Final Exam, only for Discussion)** Introduction of Clinical Data Management- Data and Databases, Data Entry, Transcribing Data, Managing Laboratory Data, Collection of Adverse Events Data, Medical Coding, Creating Reports, Data Acquisition and Database Closure, Data Transfers, Audit trial, QA in CDM.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	S	VS	VS
CO2	VS	S	VS	VS	VS
CO3	VS	VS	M	S	S
CO4	VS	VS	VS	M	VS
CO5	VS	VS	S	S	M
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Richard K. Rondel, Sheila A. Varley, Colin F. Webb. (2008). Clinical Data Management. 1st Edition. Wiley.
2. Edward H. Shortliffe, James J. Cimino. (2013). Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics). 4th Edition. Springer.
3. Sunil Gupta. (2019). Clinical Data Quality Checks for CDISC Compliance Using SAS. 1st. Edition.
4. Chandan K. Reddy, Charu C. Aggarwal (2023). Healthcare Data Analytics Paperback – 1. chapman & hall.

5. Lisa M. Sullivan. (2011). Essentials of Biostatistics in Public Health. 2nd Edition. Jones and Bartlett Publishers, Inc.
6. Wayne W. Daniel, Chad L. Cross (2013). Biostatistics: A Foundation for Analysis in the Health Sciences (Wiley Series in Probability and Statistics). 10th Edition. John Wiley & Sons Inc.
7. Andreas Holzinger. (2016). Machine Learning for Health Informatics: State-of-the-Art and Future Challenges: 9605 (Lecture Notes in Computer Science). Springer International Publishing AG.
8. Li J, Yang Q, Tan AH. (2006). Data Mining for Biomedical Applications: PAKDD 2006 Workshop, BioDM 2006, Singapore, April 9, 2006, Proceedings. Springer Science & Business Media.
9. Janet L. Peacock; Sally M. Kerry. (2006). Presenting Medical Statistics from Proposal to Publication: A Step-by-step Guide. 1st Edition. Oxford Academic.

Related Online Contents:

1. https://www.authoraid.info/en/resources/
2. https://www.srb.org.au/
3. https://saberbio.wildapricot.org/
4. https://pubmed.ncbi.nlm.nih.gov/
5. https://www.researchgate.net/

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EVEN SEMESTER

VALUE ADDED COURSE 5: MEDICAL CODING

Course Code	BM48VAC5	Course Type	Value Added	L	T	P	C	Syllabus version	2022-2023
				1	1	-	2		
Pre-requisite	Basic knowledge on anatomy, pathology and pharmacy								

Course Objectives:

- To provide an understanding of the structure and relationships within the US and Indian healthcare systems, focusing on the roles of patients, providers, and payers.
- To develop a comprehensive understanding of medical terminology, anatomy, and pathophysiology, crucial for accurate coding.
- To offer detailed training on ICD-9-CM coding, including its history, conventions, and guidelines, covering a wide range of medical conditions and procedures.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the differences between the healthcare systems in the US and India and the roles of various stakeholders.	K1, K2
CO2	• Demonstrate proficiency in medical terminology, anatomy, and pathophysiology, with the ability to accurately apply this knowledge in coding.	K1, K3
CO3	• Accurately use ICD-9-CM coding systems for a wide range of medical conditions, understanding the specific guidelines and conventions.	K2, K7
CO4	• Correctly apply CPT and HCPCS codes, understanding the different categories, sections, and the significance of modifiers.	K7
CO5	• Ensure accuracy and compliance in coding practices, adhering to legal and ethical standards.	K3
K1 - Remembering; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit I	Introduction to US Healthcare: Healthcare in India and US, Patient, Provider and Payers Relationship, Importance and significance of coding in today's world
Unit II	Anatomy, Terminology and Pathophysiology- Infections and Parasitic Diseases, Neoplasms, Endocrine, Nutritional and metabolic diseases, and immunity disorders, Diseases of blood and blood forming organs, Mental disorders, Diseases of Nervous system, Diseases of Sense organs, Diseases of Circulatory System, Diseases of Respiratory system, Diseases of Digestive system, Diseases of Genitourinary system, Complications of

	Pregnancy, Childbirth and Puerperium, Diseases of the skin and subcutaneous tissue, Diseases of musculoskeletal system and connective tissue , Congenital anomalies, Certain Conditions originating in the perinatal period. Injury and Poisoning, External causes of Injury
Unit III	ICD-9-CM - History, Volumes Conventions, General Coding Guidelines, Chapter Specific Guidelines, – E-codes , Supplementary classification of factors influencing health status and contact with health services – V-codes.
Unit IV	Current Procedural Terminology - Introduction to CPT, Category I to Category III , Six sections of CPT in Detail Evaluation and Management Anesthesiology Surgery Radiology Pathology and Laboratory Medicine, Significance of Parent codes, CPT Modifiers, Symbols and significance, Alphanumeric codes overview of categories II and III.
Unit V	HCPCS (Healthcare Common Procedure Coding System) Introduction to HCPCS, Significance and Usage, Types of HCPCs, Modifiers Level II HCPCS
Current Contours	**(Not for Final Exam, only for Discussion)** Professional Guidelines: AAPC (American Academy of Professional Coders): Provides comprehensive resources, guidelines, and certification information. AHIMA (American Health Information Management Association): Offers resources on coding standards and best practices. Certification Bodies: AAPC: Offers certifications like CPC for medical coders. AHIMA: Provides certifications such as CCS for coding professionals.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	VS	VS	VS	S	S
CO2	VS	VS	VS	VS	M
CO3	VS	M	S	M	VS
CO4	VS	VS	VS	VS	VS
CO5	VS	S	VS	VS	VS
VS-Very Strong; S-Strong; M-Moderate					

Recommended References:

1. Carol J. Buck. (2017). "Step-by-Step Medical Coding": A fundamental resource for learning the basics of medical coding, including practical exercises.
2. Sandra L. Johnson (2012). "Understanding Medical Coding: A Comprehensive Guide":

Offers an in-depth exploration of medical coding concepts and applications.
3. Ann Ehrlich and Carol L. Schroeder. (2008). "Medical Terminology for Health Professions": Essential for mastering medical terminology.

Related Online Contents:

1. https://codingclarified.com/free-medical-coding-resources/
2. https://www.ahima.org/education-events/medical-coding-hub/
3. https://www.aapc.com/resources/t/medical-coding
4. https://www.aapc.com/tools/
5. https://www.henryharvin.com/ppc3/medical-coding-course?utm_source=google&utm_medium=cpc&utm_campaign=medical_coding_search_India_25&gad_source=1&gclid=Cj0KCQjwmt24BhDPARIsAJFYKk1MslmB
6. CDC (Centers for Disease Control and Prevention): Offers updates and guidelines on ICD coding systems - (https://search.cdc.gov/search/?query=Offers%20updates%20and%20guidelines%20on%20ICD%20coding%20systems&dpage=1).

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L- Lectures, T- Tutorial, P-Practical, C- Credits