ANNA UNIVERSITY, CHENNAI

NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES

REGULATIONS 2021

CHOICE BASED CREDIT SYSTEM

B.TECH. PHARMACEUTICAL TECHNOLOGY

CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

SEMESTER I

S. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
THEORY								
2.	HS3151	Professional English - I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE3172	அறிவியல் தமிழ் / Scientific Thoughts in Tamil	HSMC	1	0	0	1	1
PRACTICALS								
8.	GE3171	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9.	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10.	GE3172	English Laboratory $	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

$ Skill Based Course

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS3251	Professional English - II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3258	Physics of Materials	BSC	3	0	0	3	3
4.	BE3252	Basic Electrical, Electronics and Instrumentation Engineering	HSMC	3	0	0	3	3
5.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
6.	GE3252	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	1
7.		NCC Credit Course Level 1[#]	-	2	0	0	2	2
PRACTICALS								
8.	GE3271	Engineering Practices Laboratory	ESC	0	0	4	4	2
9.	BE3272	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	0	0	4	4	2
10.	GE3272	Communication Laboratory / Foreign Language [$]	EEC	0	0	4	4	2
			TOTAL	**17**	**1**	**16**	**31**	**23**

[#] NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
$ Skill Based Course

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3351	Transform and Partial Differential Equations	BSC	3	1	0	4	4
2.	PY3301	Chemical Process Calculations	PCC	2	1	0	3	3
3.	BT3352	Microbiology	PCC	3	0	0	3	3
4.	PY3302	Pharmaceutical Chemistry	PCC	3	0	0	3	3
5.	BT3392	Biochemistry	PCC	3	0	0	3	3
6.	PY3391	Human Anatomy and Physiology	PCC	3	0	0	3	3
PRACTICALS								
7.	PY3311	Microbiology Laboratory	PCC	0	0	3	3	1.5
8.	PY3312	Biochemistry and Physiology Laboratory	PCC	0	0	3	3	1.5
9.	GE33361	Professional Development[$]	EEC	0	0	2	2	1
			TOTAL	**17**	**2**	**8**	**27**	**23**

[$] Skill Based Course

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PY3401	Applied Chemical Engineering Thermodynamics	PCC	2	1	0	3	3
2.	PY3402	Fluid Mechanics	PCC	3	0	0	3	3
3.	PY3403	Cell and Molecular Biology	PCC	3	0	0	3	3
4.	PY3404	Physical Pharmaceutics	PCC	3	0	0	3	3
5.	PY3405	Pharmaceutical Analysis	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2#		3	0	0	3	3
PRACTICALS								
8.	PY3411	Pharmaceutical Chemistry Laboratory	PCC	0	0	3	3	1.5
9.	PY3412	Physical Pharmaceutics Laboratory	PCC	0	0	3	3	1.5
10.	PY3513	Industrial Training/Internship I*	EEC	-	-	-	-	-
			TOTAL	**16**	**1**	**6**	**23**	**20**

NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

*Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PY3501	Pharmaceutical Dosage Forms	PCC	3	0	0	3	3
2.	PY3502	Unit Operations in Pharmaceutical Industries	PCC	3	1	0	4	4
3.	PY3503	Pharmacology	PCC	3	0	0	3	3
4.		Professional Elective I	PEC	3	0	0	3	3
5.		Professional Elective II	PEC	3	0	0	3	3
6.		Professional Elective III	PEC	3	0	0	3	3
7.		Mandatory Course-I&	MC	3	0	0	3	0
PRACTICALS								
8.	PY3511	Dosage Forms Laboratory	PCC	0	0	3	3	1.5
9.	PY3512	Pharmacology Laboratory	PCC	0	0	3	3	1.5
10.	PY3513	Industrial Training/Internship I**	EEC	0	0	0	0	2
			TOTAL	**18**	**1**	**6**	**25**	**24**

& Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

**Two weeks industrial training/internship carries one credit. Industrial training/Internship during IV Semester Summer Vacation will be evaluated in V semester

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PY3601	Heat and Mass Transfer Operations	PCC	3	1	0	4	4
2.	PY3602	Instrumental techniques in drug analysis	PEC	3	0	0	3	3
3.		Open Elective – I*	OEC	3	0	0	3	3
4.		Professional Elective IV	PEC	3	0	0	3	3
5.		Professional Elective V	PEC	3	0	0	3	3
6.		Professional Elective VI	PEC	3	0	0	3	3
7.		Mandatory Course-II[&]	MC	3	0	0	3	0
8.		NCC Credit Course Level 3[#]		3	0	0	3	3 #
PRACTICALS								
9.	PY3611	Heat & Mass Transfer Operations Laboratory	PCC	0	0	3	3	1.5
10.	PY3612	Instrumental Techniques In Drug Analysis Laboratory	PCC	0	0	3	3	1.5
11.	PY3711	Industrial Training/Internship II**	EEC	-	-	-	-	-
			TOTAL	**21**	**1**	**6**	**28**	**22**

*Open Elective – I shall be chosen from the emerging technologies.

**Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

[&] Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC- II)

[#] NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

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PROGRESS THROUGH KNOWLEDGE

SEMESTER VII/VIII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PY3701	Regulatory requirements in Pharmaceutical Industries	PCC	3	0	0	3	3
2.	PY3702	Biopharmaceutics and Pharmacokinetics	PCC	3	0	0	3	3
3.	GE3791	Human values and Ethics	HSMC	2	0	0	2	2
4.		Elective - Management #	HSMC	3	0	0	3	3
5.		Open Elective – II**	OEC	3	0	0	3	3
6.		Open Elective – III***	OEC	3	0	0	3	3
7.		Open Elective – IV***	OEC	3	0	0	3	3
PRACTICALS								
8.	PY3711	Industrial Training/Internship II##	EEC	-	-	-	-	2
			TOTAL	**20**	**0**	**0**	**20**	**22**

*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

**Open Elective – II shall be chosen from the emerging technologies.

***Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes

Elective- Management shall be chosen from the Elective Management courses

##Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

SEMESTER VIII/VII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	PY3811	Internship#/ Project Work	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

#15 weeks of continuous Internship in an organization carries 10 credits.

TOTAL CREDITS: 166

ELECTIVE – MANAGEMENT COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE3751	Principles of Management	HSMC	3	0	0	3	3
2.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
3.	GE3753	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE3754	Human Resource Management	HSMC	3	0	0	3	3
5.	GE3755	Knowledge Management	HSMC	3	0	0	3	3
6.	GE3792	Industrial Management	HSMC	3	0	0	3	3

MANDATORY COURSES I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Management	MC	3	0	0	3	0

MANDATORY COURSES II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with traditional practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

PROGRESS THROUGH KNOWLEDGE

PROFESSIONAL ELECTIVE COURSES : VERTICALS

Vertical I **Drug Design & Development**	Vertical II **Formulation and Manufacturing Technology**	Vertical III **Quality Control and Quality Assurance**	Vertical IV **Pharmaceutical Industrial Management**
Medicinal Chemistry	Technology of Fine Chemicals and Bulk drugs	Biological spectroscopic techniques	Pharmaceutical Production Management
Bioinformatics and Cheminformatics	Pre formulation Technology	Quality Assurance in Pharmaceutical Industries	Pharmaceutical Supply Chain Management
Protein Structure, Function and Proteomics	Manufacturing Technology of Dosage Forms	Audits and regulatory compliance	Safety and Disaster Management
Computer Aided Drug Design	Industrial Process and Scale up Techniques	Validation in Pharmaceutical Industries	Management Information System
Regulatory Toxicology	Novel Drug Delivery Systems	Quality Management system	Industrial Psychology And Human Resource Management
Clinical Research and Pharmacovigilance	Pharmaceutical Packaging Technology	Product development and technology transfer	Project Management for Pharmaceutical Technology

Registration of Professional Elective Courses from Verticals:
Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to Regulations 2021 Clause 4.10.

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL I: DRUG DESIGN & DEVELOPMENT

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PY3001	Medicinal Chemistry	PEC	3	0	0	3	3
2.	PY3002	Bioinformatics and Cheminformatics	PEC	3	0	0	3	3
3.	PY3003	Protein Structure, Function and Proteomics	PEC	3	0	0	3	3
4.	CPY331	Computer Aided Drug Design	PEC	3	0	0	3	3
5.	PY3004	Regulatory Toxicology	PEC	3	0	0	3	3
6.	PY3005	Clinical Research and Pharmacovigilance	PEC	3	0	0	3	3

VERTICAL II: ENERGY ENGINEERING

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PY3006	Technology of Fine Chemicals and Bulk drugs	PEC	3	0	0	3	3
2.	PY3007	Pre formulation Technology	PEC	3	0	0	3	3
3.	PY3008	Manufacturing Technology of Dosage Forms	PEC	3	0	0	3	3
4.	PY3009	Industrial Process and Scale up Techniques	PEC	3	0	0	3	3
5.	PY3010	Novel Drug Delivery Systems	PEC	3	0	0	3	3
6.	PY3011	Pharmaceutical Packaging Technology	PEC	3	0	0	3	3

VERTICAL III: QUALITY CONTROL AND QUALITY ASSURANCE

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PY3012	Biological spectroscopic techniques	PEC	3	0	0	3	3
2.	PY3013	Quality Assurance in Pharmaceutical Industries	PEC	3	0	0	3	3
3.	PY3014	Audits and regulatory compliance	PEC	3	0	0	3	3
4.	PY3015	Validation in Pharmaceutical Industries	PEC	3	0	0	3	3
5.	PY3016	Quality Management system	PEC	3	0	0	3	3
6.	PY3017	Product development and technology transfer	PEC	3	0	0	3	3

VERTICAL IV: PHARMACEUTICAL INDUSTRIAL MANAGEMENT

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PY3018	Pharmaceutical Production Management	PEC	3	0	0	3	3
2.	PY3019	Pharmaceutical Supply Chain Management	PEC	3	0	0	3	3
3.	PY3020	Safety and Disaster Management	PEC	3	0	0	3	3
4.	PY3021	Management Information System	PEC	3	0	0	3	3
5.	PY3022	Industrial Psychology And Human Resource Management	PEC	3	0	0	3	3
6.	PY3023	Project Management for Pharmaceutical Technology	PEC	3	0	0	3	3

OPEN ELECTIVES

Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories.

OPEN ELECTIVE I AND II
(EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OCS351	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2.	OCS352	IoT Concepts and Applications	OEC	2	0	2	4	3
3.	OCS353	Data Science Fundamentals	OEC	2	0	2	4	3
4.	OCS354	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3
3.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
4.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
5.	OME353	Renewable Energy Technologies	OEC	3	0	0	3	3
6.	OME354	Applied Design Thinking	OEC	2	0	2	4	3
7.	OMF351	Reverse Engineering	OEC	3	0	0	3	3
8.	OMF353	Sustainable Manufacturing	OEC	3	0	0	3	3
9.	OAU351	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
10.	OAS352	Space Engineering	OEC	3	0	0	3	3
11.	OIM351	Industrial Management	OEC	3	0	0	3	3
12.	OIE354	Quality Engineering	OEC	3	0	0	3	3
13.	OSF351	Fire Safety Engineering	OEC	3	0	0	3	3
14.	OML351	Introduction to non-destructive testing	OEC	3	0	0	3	3
15.	OMR351	Mechatronics	OEC	3	0	0	3	3
16.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
17.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3
18.	OGI351	Remote Sensing Concepts	OEC	3	0	0	3	3
19.	OAI351	Urban Agriculture	OEC	3	0	0	3	3
20.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3
21.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
22.	OEI353	Introduction to PLC	OEC	3	0	0	3	3

		Programming						
23.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
24.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
25.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
26.	OCH351	Nano Technology	OEC	3	0	0	3	3
27.	OCH352	Functional Materials	OEC	3	0	0	3	3
28.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
29.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
30.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
31.	OPE351	Introduction to Petroleum Refining and Petrochemicals	OEC	3	0	0	3	3
32.	OPE352	Energy Conservation and Management	OEC	3	0	0	3	3
33.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
34.	OEC351	Signals and Systems	OEC	3	0	0	3	3
35.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
36.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
37.	OBM352	Assistive Technology	OEC	3	0	0	3	3
38.	OMA352	Operations Research	OEC	3	0	0	3	3
39.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
40.	OMA354	Linear Algebra	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
3.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
4.	OMA356	Random Processes	OEC	3	0	0	3	3
5.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
6.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
7.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
8.	OME352	Additive Manufacturing	OEC	3	0	0	3	3
9.	OME353	New Product Development	OEC	3	0	0	3	3
10.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	2	0	2	4	3
11.	OMF352	Micro and Precision Engineering	OEC	3	0	0	3	3

12.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
13.	OAU352	Batteries and Management system	OEC	3	0	0	3	3
14.	OAU353	Sensors and Actuators	OEC	3	0	0	3	3
15.	OAS353	Space Vehicles	OEC	3	0	0	3	3
16.	OIM352	Management Science	OEC	3	0	0	3	3
17.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
18.	OIE353	Operations Management	OEC	3	0	0	3	3
19.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
20.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
21.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3
22.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
23.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
24.	OMR353	Sensors	OEC	3	0	0	3	3
25.	ORA352	Foundation of Automation	OEC	3	0	0	3	3
26.	ORA353	Concepts in Mobile Robotics	OEC	3	0	0	3	3
27.	OMV351	Marine Propulsion	OEC	3	0	0	3	3
28.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3
29.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
30.	OAE353	Drone Technologies	OEC	3	0	0	3	3
31.	OGI352	Geographical Information System	OEC	3	0	0	3	3
32.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
33.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
34.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
35.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
36.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3
37.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
38.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
39.	OCH353	Energy Technology	OEC	3	0	0	3	3
40.	OCH354	Surface Science	OEC	3	0	0	3	3
41.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
42.	OTT355	Fibre Science	OEC	3	0	0	3	3
43.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
44.	OPE353	Industrial safety	OEC	3	0	0	3	3
45.	OPE354	Unit Operations in Petro Chemical Industries	OEC	3	0	0	3	3
46.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
47.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
48.	OEC353	VLSI Design	OEC	3	0	0	3	3

49.	OEC354	Industrial IoT and Industry 4.0	OEC	2	0	2	4	3
50.	OBM353	Wearable devices	OEC	3	0	0	3	3
51.	OBM354	Medical Informatics	OEC	3	0	0	3	3

SUMMARY

B.TECH. PHARMACEUTICAL TECHNOLOGY										
S.No	**Subject Area**	**Credits per Semester**								**Total Credits**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII/VIII**	**VIII/VII**	
1	**HSMC**	**4**	**6**					**5**		**15**
2	**BSC**	**12**	**7**	**4**	**2**					**25**
3	**ESC**	**5**	**8**							**13**
4	**PCC**			**18**	**18**	**13**	**7**	**6**		**62**
5	**PEC**					**9**	**12**			**21**
6	**OEC**						**3**	**9**		**12**
7	**EEC**	**1**	**2**	**1**		**2**		**2**	**10**	**18**
8	**Non-Credit /(Mandatory)**					√	√			
Total		**22**	**23**	**23**	**20**	**24**	**22**	**22**	**10**	**166**

PROGRESS THROUGH KNOWLEDGE

Enrollment for B.E. / B. Tech. (Honours) / Minor degree (Optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.
Complete details are available in clause 4.10 of Regulations 2021.

VERTICALS FOR MINOR DEGREE (In additions to all the verticals of other programmes)

Vertical I Fintech and Block Chain	**Vertical II Entrepreneurship**	**Vertical III Public Administration**	**Vertical IV Business Data Analytics**	**Vertical V Environment and Sustainability**
Financial Management	Foundations of Entrepreneruship	Principles of Public Administration	Statistics For Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Constitution of India	Datamining For Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management For Business	Administrative Theories	Marketing And Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation And Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL 1: FINTECH AND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL 2: ENTREPRENEURSHIP

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneruship	PEC	3	0	0	3	3
2.	CMG338	Team Building & Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management For Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

PROGRESS THROUGH KNOWLEDGE

VERTICAL 3: PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL 4: BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics For Management	PEC	3	0	0	3	3
2.	CMG350	Datamining For Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing And Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation And Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

ANNA UNIVERSITY
PROGRESS THROUGH KNOWLEDGE

MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4

OBJECTIVES

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems?
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9 +3

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9 + 3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 9 + 3

Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9 + 3

Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

TOTAL: 60 PERIODS

Course outcomes:

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.

2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.

REFERENCES:

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016.
4. Narayanan. S., ManicavachagomPillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6. Wylie. R.C. and Barrett . L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PY3301 CHEMICAL PROCESS CALCULATIONS

L	T	P	C
2	1	0	3

OBJECTIVES

The course aims to,

● learn about the basic calculation techniques used in process industries

● learn the laws about the behaviour of gases, liquids and solids, for analysing and designing chemical processing equipment with the help of data sources containing relevant physical and chemical properties.

UNIT I UNITS AND DIMENSIONS 9

Fundamental and derived units, conversion, dimensional consistency of equations, conversions of equations, Dimensional and dimensionless constants, mass and volume relations, Stoichiometric and composition relations.

UNIT II IDEAL GASES AND VAPOUR PRESSURE 9

Ideal gas law, Dalton's Law, Amagat's Law and Average molecular weight of gaseous mixtures. Effect of temperature on vapour pressure, Vapour pressure plot (Cox chart), Vapour pressures of miscible and immiscible liquids and solutions, Raoult's Law and Henry's Law.

UNIT III HUMIDITY AND SOLUBILITY 9

Partial saturation, Humidity- Absolute Humidity, Vaporization process, Molal humidity, Relative and percentage saturation, dew point, humid heat, wet bulb and dry bulb temperatures, use of humidity charts, adiabatic vaporization and adiabatic saturation temperature.

UNIT IV MATERIAL BALANCE 9

Tie substance, limiting reactant, excess reactant, General material balance equation for steady and unsteady state, Typical steady state material balances in distillation, absorption, extraction, crystallization. Combustion of coal, fuel gases and sulphur – Recycling operations – Bypassing streams – Degree of conversion – Excess reactant – Limiting reactant Selectivity and Yield.

UNIT V ENERGY BALANCE 9

General steady state energy balance equation, Heat capacity, Enthalpy, Heat of formation, Heat of reaction, Heat of combustion and Calorific values. Heat of solution, Heat of mixing, Heat of crystallization, determination of ΔHR at standard and elevated temperatures, Theoretical flame temperature and adiabatic flame temperature.

SELF STUDY TOPICS (NOT FOR EXAMINATIONS)

Process flow diagram/chart for material and energy balances, Material and energy balances for Chemical reactors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Have a clear idea of various types of unit systems and they will be able to convert units from one form to another.
2. Comprehend the different gas laws, and enable the students to solve the problems on stoichiometry quantity of gaseous substances in industry.
3. Know the various measurements of humidity and clear about applying humidity charts, psychometric charts, and concepts of vaporization and vapor pressure laws
4. analyze the behaviour of recycle processes, performing approximate material balances by hand and setting up calculations for rigorous solution by computer.
5. attain the energy balance concepts necessary for solution of energy balance of different chemical engineering processes in industries
6. Independently develop a stoichiometry problem solving ability in a number of useful mathematical and chemical operations.

TEXT BOOKS:

1. Narayanan, K.V. and Lakshmikutty, B. “Stoichiometry and Process Calculations”, 2nd Edition. PHI Learning Pvt. Ltd., 2017
2. Bhatt, B.I. and Thakore, S.M., “Stoichiometry", 5th Edition, Tata McGraw Hill, Education Pvt. Ltd, 2017. 3. Gavhane, K. A. “Introduction to Process Calculations”, Nirali Publication, 2016.

REFERENCES:

1. Venkataramani, V., Anantharaman, N. and Meera Sheriffa Begum K. M. “Process Calculations”, 2nd ed.PHI Learning Pvt. Ltd., 2011
2. Himmelblau, D. M. and Riggs, B. J. “Basic Principles and Calculations in Chemical Engineering", 8th Edition, Prentice Hall International series, 2015.
3. Sikdar, C.D., "Chemical Process Calculations", PHI Learning Pvt. Ltd., 2013.

Course articulation matrix

Course outcome	Programme Outcome												Programme Specific outcome			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3				3	2		2			2				
CO2	3	3				2	2		2						3	
CO3	3	3	2		3	2			2						3	2
CO4	3	3	3		3	2	3								3	2
CO5	3	3	2		3		3								3	2
CO6	3	3	2		3				2						3	
Average CO	3	3	2.25		3		2.5		2			2			3	2

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate(Medium) and Substantial (High) respectively.)

BT3352 **MICROBIOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
- To solve the problems in microbial infection and their control.

UNIT I INTRODUCTION 9

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION 9

Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 9

Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV CONTROL OF MICROORGANISMS 9

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY 9

Primary metabolites; secondary metabolites and their applications; preservation of food;production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TOTAL: 45 PERIODS

TEXT BOOKS

1. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India,2009
2. Prescott L.M., Harley J.P., Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.

REFERENCE BOOKS

1. Black, Text book of microbiology. Freeman Publishers,2016
2. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.
3. Ananthanarayan, CK Jayaram Panikars. Text book of Microbiology, 2005, Orient Blackswan Publishers.

PROGRESS THROUGH KNOWLEDGE

PY3302 PHARMACEUTICAL CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To inculcate understanding of the properties and principles of medicinal agents that originates from organic and inorganic sources and their application in pharmaceutical industry.
- To provide the basic functional group identification, molecular rearrangement, chemical bonding with their reaction mechanism.
- To provide the fundamental principles involved in the identification, preparation of pharmaceutical aids and to apply the principle of coordination compounds in pharmaceutical substances.

UNIT I STRUCTURE AND PROPERTIES 9

Atomic orbitals, molecular orbitals theory, wave equation, bonding and antibonding orbitals, hybrid orbitals, covalent bond, polarity of bonds and molecules, dipole moment, resonance, inductive, mesomeric and electromeric effects, intramolecular and intermolecular hydrogen bonding, Isomers, optical activity, stereoisomerism, specification of configuration, chirality,

UNIT II CHEMISTRY OF ALIPHATIC, AROMATIC AND HETEROAROMATIC COMPOUNDS 9

Characteristics of organic compounds, structure, nomenclature, preparation and reaction mechanism of alkyl and aryl halides, Nucleophilic aliphatic substitution reaction, Elimination reactions, electrophilic addition reactions, Markownikoff's orientation, AntiMarkownikoff's orientation. Huckel's rule, structures, synthesis, properties and chemical reactions of benzenoid and nonbenzenoid compounds, Electrophilic aromatic substitution reaction, General principles of heterocyclic synthesis – Methods of preparation and reactions of Pyridines – Pyrroles – Thiophenes – Furans – Quinolines – Isoquinolines.

UNIT III QUALITY CONTROL OF DRUGS AND PHARMACEUTICALS 9

Importance of quality control, significant errors, methods used for quality control, History of Pharmacopoeia, Identification and characterization of impurities in Pharmaceutical substances, Limit tests: Definition, importance, general procedure for limit test for chlorides, sulphates, iron, arsenic, heavy metals and lead with suitable examples. Identification test for Magnesium hydroxide, Ferrous sulphate, Calcium gluconate, Copper sulphate. Test for purity: Swelling power of Bentonite, Neutralizing capacity of aluminum hydroxide gel, Determination of potassium iodate and iodine in potassium Iodide Preparation of inorganic pharmaceuticals: Boric acid, Potash alum and Ferrous sulphate.

UNIT IV STUDY OF ORGANIC REACTIONS AND MOLECULAR REARRANGEMENTS 9

Alder Reaction, Formylation reactions, Gattermann Reaction, Gattermann-Koch reaction, Vilsmeier reaction, Azide-Alkyne Cycloaddition, Catalytic hydrogenation, Meerwein-Ponndorf-Verley, Birch reduction, Clemmenson, Sandmeyer, Haloform reactions, Azo coupling, Beckmann Rearrangement, Benzidine rearrangement.

UNIT V RADIOPHARMACEUTICALSAND CO-ORDINATION COMPOUNDS 9

Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I^{131}, Storage conditions, precautions & pharmaceutical application of radioactive substances. Theory of co-ordination compounds with special reference to application in Pharmacy: EDTA, Dimercaprol, Penicillamine, 1, 10-Phenanthroline.

TOTAL: 45 PERIODS

SELF STUDY TOPICS (NOT FOR EXAMINATIONS)

Indian Pharmacopoeia, United States Pharmacopeia, British Pharmacopoeia, European Pharmacopoeia, International Pharmacopoeia

COURSE OUTCOMES:

After completion of the course the student will be able to

- identifythe relationship between structure and physical propertiespharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.
- draw the structures and outline the synthesis of simple pharmaceutically active organic compounds having five and six membered heterocyclic compounds.
- describe the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.
- distinguish between various reaction mechanism and well acquainted with the synthesis of some important class of drugs.
- apply the knowledge in the handling of radiopharmaceuticals and synthesis of new drug molecule with special reference to organic, inorganic and coordination chemistry.

TEXT BOOKS:

1. V.Algarsamy, Pharmaceutical Organic Chemistry, Kindle edition, 2020.
2. V.N.Rajasekaran, Textbook of Pharmaceutical Inorganic Chemistry Theory and Practical, CBS Publishers, 2019
3. R.K. Sharma, Text Book of Coordination Chemistry, 1st Edition,Discovery Publishing House Pvt. Ltd.2011.

REFERENCES:

1. Jr. Leroy G. Wade , Jan William Simek , Maya Shankar Singh , Organic Chemistry, 9 Edition, Pearson Publisher, 2019
2. L.M. Atherden, Bentley and Driver's Textbook of Pharmaceutical Chemistry, 8th Edition, Oxford Publisher, 2020
3. P. L. Soni, VandnaSoni,The Chemistry of Coordination Complexes and Transition Metals, 1st Edition, CRC Press, 2021.
4. Jie Jack Li, Name Reactions A Collection of Detailed Mechanisms and Synthetic Applications, 6th Edition, Springer Publisher, 2021.

Course Articulation Matrix

	ProgrammeOutcomes(PO)												**Programme specific outcomes (PSO)**			
Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	3				2	1			2		2	3			2
CO2	3	2	3				1			2		2	2		3	
CO3	3	3	3				2			2		2	3		3	
CO4	3	1		3			1			2		2	2		3	
CO5	3	1		3			1			2		2	3			1
CO6	3	1		3		2	2	2	2	2		2	3		3	2
Average CO	3	1.8	3	3	-	2	1.3	2	2	2	-	2	2.3	-	3	1.6

BT3392 BIOCHEMISTRY L T P C
3 0 0 3

OBJECTIVE

To enable students learn the fundamentals of Biochemical Processes and Biomolecules

UNIT I INTRODUCTION TO BIOMOLECULES - CARBOHYDRATES: 9

Basic principles of organic chemistry, role of carbon, types of functional groups, chemical, nature of water, pH and biological buffers, bio molecules structure and properties of Carbohydrates (mono, di, oligo & polysaccharides) Proteoglycans, glucosaminoglycans. mutarotation, glycosidic bond, reactions of monosaccharides, reducing sugars. Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulfate

UNIT II STRUCTURE AND PROPERTIES OF OTHER BIOMOLECULES 9

Structure and properties of Important Biomolecules.

Lipids: fatty acids, glycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglandins.

Protein: Amino Acids, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determine of primary structure.

Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, RNA, DNA-Watson-Crick structure of DNA, reactions, properties, measurement, nucleoprotein complexes

UNIT III METABOLISM CONCEPTS AND CARBOHYDRATE METABOLISM 9

Functions of Proteins, Enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites. Interconnection of pathways and metabolic regulation. Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt & glyoxalate shunt.

UNIT IV INTERMEDIARY METABOLISM AND REGULATION 9

Fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

UNIT V PROTEIN TRANSPORT AND DEGRADATION 9

Protein targeting, signal sequence, secretion; Folding, Chaperone and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover.

TOTAL: 45 PERIODS

OUTCOMES

- To ensure students have a strong foundation in the structure and reactions of Biomolecules.
- To introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.
- To correlate Biochemical processes with Biotechnology applications.

TEXT BOOKS

1. Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Cox W.H.Freeman and Company 2017
2. Satyanarayana, U. and U. Chakerapani, “Biochemistry” 3rd Rev. Edition, Books & Allied (P) Ltd., 2006.
3. Rastogi, S.C. “Biochemistry” 2nd Edition, Tata McGraw-Hill, 2003.
4. Conn, E.E., etal., “Outlines of Biochemistry” 5th Edition, John Wiley & Sons, 1987.
5. Outlines of Biochemistry, 5th Edition: By E E Conn, P K Stumpf, G Bruening and R Y Doi. pp 693. John Wiley and Sons, New York. 1987.

REFERENCES

1. Berg, Jeremy M. et al. "Biochemsitry", 6th Edition, W.H. Freeman & Co., 2006.
2. Murray, R.K., etal "Harper's Illustrated Biochemistry", 31st Edition, McGraw-Hill, 2018.
3. Voet, D. and Voet, J.G., "Biochemistry", 4th Edition, John Wiley & Sons Inc.,2010.

PY3391 HUMAN ANATOMY AND PHYSIOLOGY L T P C
3 0 0 3

OBJECTIVES:

To explain the gross morphology, structure and functions of various organs of the human body and describe the various homeostatic mechanism and their imbalance.

UNIT I HEMOPOIETIC SYSTEM 9

Composition and functions of blood, Hemopoiesis, blood components, blood groups, clotting factors and mechanism of coagulation, platelets.

UNIT II CARDIOVASCULAR SYSTEM 9

Anatomy and function of the heart, circulation: pulmonary, coronary, and systematic circulation; electrocardiogram (ECG), cardiac cycle and heart sounds, blood pressure - its maintenance and regulation.

UNIT III RESPIRATORY SYSTEM 9

Anatomy of respiratory organs and functions, mechanism/physiology of respiration and regulation of respiration, transport of respiratory gases, respiratory volumes and capacities.

UNIT IV NERVOUS SYSTEM 9

Classification of the nervous system, anatomy, physiology, and functional areas of the cerebrum, cerebellum, midbrain, thalamus, hypothalamus and basal ganglia, spinal cord: structure and reflexes.

UNIT V ENDOCRINE SYSTEM 9

Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal glands, pancreas, pineal gland, thymus**.**

TOTAL 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Acquire the gross histology, structure and functions of various organs of the human body
2. Implement the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body
3. Perform basic physiological and pharmacological experiments and to record and interpret the results for its clinical significance.
4. Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system
5. Interpret graphs of anatomical and physiological data.
6. Apply the methods to evaluate the potency of drugs, toxicity of drugs in animal models.

TEXTBOOKS

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrjee, Academic Publishers Kolkata.

REFERENCE BOOKS

1. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York.

2. Vander's Human Physiology: The Mechanisms of Body Function, Eric Widmaier, Hershel Raff, Kevin Strang, 2015, Edition:14, Publisher: McGraw-Hill
3. Hole's human anatomy & physiology David Shier, Ricki Lewis, Jackie Butler Year: 2019, Edition: Fifteenth, Publisher: Mcgraw hill Education
4. Germann, W.J., Stanfield, C.L. (eds.) (2002) Principles of Human Physiology, Pearson Education, Inc./ Benjamin Cummings, San Francisco, CA.
5. Guyton AC and Hall JE (eds.) (2000) Textbook of Medical Physiology, 10th edition. W.B. Saunders Co., Philadelphia, PA.
6. Tortora, G.J. and Grabowski, S.R. (eds.) (2000) Principles of Anatomy and Physiology, 9th edition. John Wiley & Sons, Inc., New York, NY.
7. Anatomy and Physiology 2e J. Gordon Betts, Tyler, Texas Kelly A. Young, Long Beach, California James A Wise, Hampton, Virginia Copyright Year: 2021

Course Articulation Matrix

	ProgrammeOutcomes(PO)												**Programme specific outcomes (PSO)**			
Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1		3					2	1	2				3		2	
CO2	3	3			2		3							3	2	
CO3		3		3	2							3			3	
CO4	3	3					3						2	3		
CO5			3		2		2								3	2
CO6	3	3	3		3		2			1			2			3
Average CO	3	3	3	3	2.2	-	2.4	1	2	1	-	3	2.3	3	2.5	2.5

PROGRESS THROUGH KNOWLEDGE

PY3311 MICROBIOLOGY LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To practically demonstrate various experimental techniques to identify the morphology, culture characteristics, propagation and control of microbes and industrial applications of microbes.

EXPERIMENTS

1. Demonstration of efficiency of sterilization techniques.
2. Preparation of various types of culture media: nutrient broth and agar
3. Culture techniques: isolation and preservation of cultures: broth: flask, test tubes; agar: pour plates, streak plates, slants, stabs
4. Microscopic identification of bacteria
5. Staining techniques: simple, differential- gram's staining, spore /capsule staining
6. Quantification of microbes: sampling and serial dilution; bacterial count, total count and viable count.
7. Determination of phenol coefficient to demonstrate efficiency of a disinfectant
8. Perform and report sensitivity of antibiotics (Disc diffusion and well diffusion)
9. Inoculate, Incubate and plot the growth curve of bacteria (E.coli)
10. Effect of pH, Temperature, UV radiation on Growth of bacteria (E.coli)
11. Determination of microbial inhibitory concentration (MIC).
12. Biochemical identification of unknown microbes
13. Demonstration of alcohol fermentation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to

1. Understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.
2. Develop the minimum skills to work on several important techniques using equipment for the study of microorganisms. Microscopically examine living microorganisms.
3. Familiar with the types of laboratory equipment and culture media needed to develop and maintain pure cultures.
4. Carry out the technique for aseptic removal and transfer of microorganisms for subculturing.
5. Determine the cultural characteristics of microorganisms as an aid in identifying and classifying organisms into taxonomic groups.
6. Practical use of the compound microscope for visualization of cellular morphology from stained slide preparations.

Equipment Needed for 1 batch

Autoclave	2
Hot Air Oven	2
Incubators	2
Light Optical Microscopes	6
Incubator Shaker	2
Colorimeter	2
Lamina Flow Chamber	2
Colony counter	2
Laminar air flow	2

REFERENCE BOOKS

1. Practical Handbook of Microbiology, Second edition, Edited by Emanuel Goldman, Lorrence H Green, CRC Press.
2. Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual", Global Edition, Pearson, 2018.

3. Collee, J.G. etal., “Mackie & Mc Cartney Practical Medical Microbiology” 4th Edition, Churchill Livingstone, 1996.

Course Articulation Matrix

	Programme Outcomes (PO)												Programme specific outcomes (PSO)			
Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3				2		2								3	2
CO2		3		3	2	3								3	2	
CO3			3	3	2		1						2			
CO4	3	3					2			2				3		
CO5			3	3			2			2		2			3	
CO6			3			3			2			2	3		2	2
Average CO	3	3	3	3	2	3	1.7	-	2	2	-	2	1.6	3	2.5	2

PY3312 BIOCHEMISTRY AND PHYSIOLOGY LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES

The course aims to,

- Learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,).
- To learn the gross histology, structure and functions of various organs of the human body and perform the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body

LISTOFEXPERIMENTS

Biochemistry

1. Qualitative tests for carbohydrates–distinguishing reducing from non-reducing sugars and keto from aldo sugars.
2. Quantitative method for aminoacid estimation usingbninhydrin–distinguishing amino from imino acid.
3. Quantitative analysis of carbohydrates (Benedict’s method etc.,)
4. Protein estimation by Biuret, Lowry’s method, Bradford and spectroscopic methods
5. Extraction of lipids and analysis byTLC.
6. Enzymatic assay:phosphatase from potato.
7. Enzymatic assay: estimation of glucose by GOD-POD method.
8. Estimation of chloride, glucose, ammonia and creatinine in urine.

Physiology

1. Study of different systems with the help of models (axial skeleton, appendicular skeleton, cardiovascular system, respiratory system, digestive system, urinary system, nervous system, special senses, reproductive system)
2. Determination of bleeding and clotting time
3. Determination of R.B.C. and W.B.C count of blood
4. Estimation of Haemoglobin
5. Determination of differential count of blood WBCs.
6. Enumeration of RBC
7. Determination of Erythrocyte Sedimentation Rate
8. Blood group determination

9. Observation of osmotic fragility of RBCs
10. Determination of packed cell volume and calculation of blood indices
11. Heart rate and blood pressure recording
12. ECG recording
13. Examination of respiratory system and recording of respiratory movements
14. Preparation of physiological solution: Ringers' solution, Tyrode solution, Krebs solution, Normal saline.

TOTAL:45 PERIODS

Course outcomes:

1. Ability to apply basic principles of chemistry to biological systems and molecular biology.
2. Correlate molecular structure and interactions present in proteins, nucleic acids, carbohydrates and lipids
3. Perform procedure to characterize the biomolecules using microscopy.
4. Acquire the gross histology, structure and functions of various organs of the human body
5. Implement the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body
6. Perform basic physiological and pharmacological experiments and to record and interpret the results for its clinical significance.

REFERENCE BOOKS:

1. Human anatomy & physiology laboratory manual. Cat version Marieb, Elaine Nicpon, Mitchell, Susan J., Smith, Lori A., Zao, Peter Z. Year: 2016 Edition: Twelfth edition, cat version. Publisher: Pearson
2. Laboratory Manual for Anatomy & Physiology Featuring Martini Art, Cat Version Year: 2016 Edition: 6th Edition Publisher: Pearson
3. Practical Biochemistry with Clinical Correlation for MBBS Students, Poonam Agrawal. Year: 2020, Edition: 1, Publisher: CBS Publishers and Distributors Pvt Ltd
4. Practical Biochemistry for Colleges, E. J. Wood (Eds.) Year: 1989 Edition: 1st ed Publisher: Pergamon Press
5. Experimental Biochemistry, Robert L. Switzer, Liam F. Garrity Year: 1999 Edition: 3rd ed Publisher: W. H. Freeman and Co
6. Principles and techniques of practical biochemistry and molecular biology. Keith Wilson, John Walker Year: 2005 Edition

Course Articulation Matrix

	ProgrammeOutcomes(PO)												**Programme specific outcomes (PSO)**			
Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
1												3	3		2	
2	3	2		3			2							3	2	
3	3			3	3			1							3	
4	3				3		3						2	3		
5	3	2		3	2					2					3	2
6	3		3		3			3					2			3
Average	3	2	3	3	2.5	-	2.5	2	-	2	-	3	2.3	3	2.5	2.5

PY3401 APPLIED CHEMICAL ENGINEERING THERMODYNAMICS

L	T	P	C
2	1	0	3

OBJECTIVES

Students will learn about the behavior of fluids, laws of thermodynamics, thermodynamic property relations and their application in different chemical processes.

UNIT I CONCEPTS OF THERMODYNAMICS 9

Scope of thermodynamics, basic concepts and definitions, Equilibrium state and phase rule, Energy, Work, Temperature and Zeroth Law of Thermodynamics, reversible and irreversible process, Ideal gas- Equation of State involving ideal and real gas, Law of corresponding states, Compressibility chart, First Law of Thermodynamics and its consequences.

UNIT II LAWS OF THERMODYNAMICS 9

Joule's experiment, internal energy, enthalpy, Application of first Law of Thermodynamics for Flow and non flow processes. Limitations of the first Law, statements of second Law of Thermodynamics and its Applications, Heat Engine and Heat Pump.

UNIT III THERMODYNAMIC POTENTIALS 9

Thermodynamic Potentials, thermodynamic correlation, Maxwell relations, criteria for Equilibria and stability. Clapeyron equation, partial molar properties, ideal and non-ideal solutions, standard states definition and choice

UNIT IV ACTIVITY COEFFICIENT 9

Activity coefficient-composition models, Gibbs-Duhem equation, effect of pressure and temperature on activity co-efficient, activity and property change of mixing, excess properties of mixtures.

UNIT V PHASE EQUILIBRIA 9

Thermodynamic consistency of phase equilibria, phase equilibria in single and multicomponent systems, Duhem's theorem, vapor-liquid equilibria and non-ideal solutions. Chemical reaction equilibria, Extent of reaction, equilibrium constant and standard free energy change

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Understand the basic concepts, laws and different process related to chemical engineering thermodynamics.
2. Identify the laws related to chemical engineering thermodynamics, thermodynamic principles, flow process and its thermodynamic application
3. Understand the thermodynamic potential, its correlation and analyze and distinguish between ideal and non-ideal solution.
4. Understand and demonstrate the activity coefficient and activity property of solution.
5. Demonstrate the Chemical and phase equilibria equations
6. Understand the interrelationships between different thermodynamic properties and become familiar with the graphs to develop an intuition for the variation of these properties during various processes.

TEXT BOOKS:

1. Sonntag, Borgnakke, Van Wylen, Fundamentals of Thermodynamics, 7th Edition, Wiley India, New Delhi, 2009.
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004
3. Smith, van Ness and Abbott, "Chemical Engineering Thermodynamics", 7th Edition, McGraw Hill, New York, 2005

REFERENCES:

1. S. I. Sandler, Chemical, Biochemical and Engineering Thermodynamics, Wiley New York, 2006
2. Y V C Rao, "Chemical Engineering Thermodynamics", Universities Press, Hyderabad 2005.
3. Pradeep ahuja," Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).

4. Gopinath Halder," Introduction to Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).

Course articulation matrix

ProgrammeOutcomes(PO)													Programme specific outcomes (PSO)			
Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3							1			2			3	2
CO2		3	3		2										3	
CO3			3	3	2	2			1	2				3		
CO4		3			3				2	1				3		
CO5	3		3	2		1							3			
CO6	3	3		3				2				2		3	2	2
Average CO	3	3	3	2.66	2.33	1.5		0.66	1.33	1.5		2	3	3	2.66	2.66

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate(Medium) and Substantial (High) respectively.)

PY3402 FLUID MECHANICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the basic fundamental knowledge about the flow properties of different types of fluids and its momentum balance.
- To provide the knowledge about the various transporting and flow measurement and fluid machineries.

UNIT I FUNDAMENTAL CONCEPTS 6

Methods of analysis and description - fluid as a continuum – Velocity and stress field - Newtonian and non-Newtonian fluids – Classification of fluid motion

UNIT II FLUID STATICS 9

Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometry – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

UNIT III DIMENSIONAL ANALYSIS 9

The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi-theorem - non-dimensional action of the basic equations - similitude - relationship between dimensional analysis and similitude

UNIT IV FLOW IN PIPES 12

Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; Line sizing; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.

UNIT V FLOW MEASUREMENT 9

Flow measurement - Constant and variable head meters; Velocity measurement techniques; Types, characteristics and sizing of valves; Classification, performance characteristics and sizing of pumps.

TOTAL : 45 PERIODS

Course Outcomes

1. Understand the fluid properties, apply the knowledge and equipments to determine the pressure by different techniques.
2. Ability to solve and analyze the mathematical model associated with physical fluid-flow system and its applications.
3. Describe the different flow pattern in various fluid ducts like pipes and fittings
4. Understand the fluid flow properties through solids and its application.
5. Know the various transporting and metering devices of fluid flow in bulk pharmaceutical manufacturing and in chemical process.
6. Understand the interrelationships between different fluid flow properties and become familiar with the graphs to utilize these properties during various manufacturing processes.

TEXT BOOKS:

1. Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Second Edition, McGraw-Hill, (1991).
2. Munson, B. R., Young, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 5th Edition“, John Wiley, 2006

REFERENCES:

1. White, F.M., “Fluid Mechanics “, IV Edition, McGraw-Hill Inc., 1999.
2. James O Wilkes and Stacy G Bike, “Fluid Mechanics for Chemical Engineers’ Prentice Hall PTR (International series in Chemical Engineering) (1999)
3. McCabe W.L, Smith, J C and Harriot. P “Unit operations in Chemical Engineering”, McGraw Hill, VII Edition, 2005

Course articulation matrix

	Programme Outcomes(PO)												**Programme specific outcomes (PSO)**			
Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3	PSO 4
CO1	3			3								2		3		
CO2		3			3					2				3		2
CO3	3			3									3			
CO4		3	3				1								3	
CO5	3	3		3	2		2		1				3			2
CO6		3	2	2	2							1	3		2	2
Average CO	3	3	2.5	2.75	2.33		1.5		1	2		1.5	3	3	2.5	2

PY3403 CELL AND MOLECULAR BIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims to,

- Enable students understand the structure and function of the prokaryotic and eukaryotic cell with its organelles.
- Expose the concepts on the genetic information in the eukaryotic cell and its regulation.
- Provide knowledge on the application of recombinant DNA technology in biotechnological research.
- Illustrate creative use of modern tools and techniques for sequencing and amplification of DNA.
- Develop students in strategizing research methodologies employing genome analysis.

UNIT I CELL STRUCTURE AND FUNCTIONS OF THE ORGANELLES 9

Prokaryotic, Eukaryotic cells, Sub-cellular organelles, membrane systems and functions Differences and similarities between prokaryotic and eukaryotic cells. Cytoskeletal proteins. Extra cellular matrix, cell-cell junctions, Cell division: mitosis, Extra- and intracellular signal transduction

UNIT II MOLECULAR GENETICS 10

Introduction to nucleic acids, Structure and function of DNA, DNA replication, Telomere replication in eukaryotes. Mutagens, DNA mutations and various types of repair mechanisms. Structure and function of mRNA, rRNA and tRNA. RNA synthesis: Initiation, elongation and termination; Elucidation of genetic code, Codon degeneracy, Wobble hypothesis, Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Posttranslational modifications and its importance. Organization of genes in prokaryotic and eukaryotic chromosomes.

UNIT III RECOMBINANT DNA TECHNOLOGY 10

Manipulation of DNA – Restriction and Modification enzymes. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for yeast, insect and mammalian systems, Prokaryotic and eukaryotic expression host systems, Introduction of recombinant DNA into host: Insulin, Interferons, Erythropoietin, DNA libraries: Construction of genomic and cDNA libraries.

UNIT IV SEQUENCING AND AMPLIFICATION OF DNA 8

Amplification of DNA; Types of PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Site directed mutagenesis. Maxam Gilbert's and Sanger Coulson's and automated methods of DNA sequencing, Next generation sequencing technologies, Genetic maps and Physical maps.

UNIT V GENOME ANALYSIS AND GENOMICS 8

Gene therapy and Transgenic technology, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Web resources for Genomics, Regulation of Eukaryotic Gene Expression by Small RNAs (RNA Interference, RNAi).

TOTAL 45 PERIODS

COURSE OUTCOMES:

After completion of the course the student will be able to

1. Acquire knowledge on the structure and functions of prokaryotic and eukaryotic cells.
2. Illustrate an overview of nucleic acids and the central dogma of life and its significance
3. Employ the knowledge of DNA manipulation techniques in the production of commercially important recombinant proteins.
4. Understand the concepts of PCR techniques and genome sequencing techniques in biotechnological applications.
5. Apply the knowledge of genome analysis and genomics in disease diagnostics and therapy.

6. Integrate knowledge of molecular biology principles for understanding of various disorders and genetic engineering principles for its diagnosis and therapy.

TEXT BOOKS:

1. David Friedfeld, “Molecular Biology.” Narosa Publications, 4th edition, 2008.
2. Primrose S B and R. Twyman “Principles of Gene Manipulation & Genomic Blackwell Science Publications, 7th edition, 2006.
3. Principles of Genome Analysis and Genomics by S.B. Primrose and R.M. Twyman, Third Edition (Blackwell Publishing), 2003.

REFERENCES:

1. Tropp, Burton. “Molecular Biology: Genes to Proteins”, 4th Edition. Jones and Bartlett, 2011.
2. David P Clark, Nanette J Pazdernik, Michelle R. McGehee." Molecular Biology", 3rd edition, Elsevier science, 2018.
3. Genomes 4 by T.A.Brown, fourth Edition (Garland Science Publishing), 2018.

Course articulation matrix

PROGRAMME OUTCOMES (PO)													**PROGRAMME SPECIFIC OUTCOMES (PSO)**			
Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1	-	-	1	-	-	-	-	-	1	-	1	-
CO2	3	1	2	1	-	-	1	-	-	-	-	-	1	-	1	-
CO3	3	3	3	3	2	-	2	1	-	-	-	-	3	-	3	2
CO4	3	3	3	2	2	-	2	-	-	-	-	-	-	-	-	2
CO5	3	3	3	3	2	-	2	-	-	-	-	1	-	-	1	2
CO6	3	3	2	2	-	-	2	-	-	-	-	2	-	-	-	2
Average CO	3	2.3	2.5	2	2	-	1.6	1	-	-	-	1.5	1.6	-	1.5	2

PROGRESS THROUGH KNOWLEDGE

PY3404 PHYSICAL PHARMACEUTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire the fundamental principles and concepts involved in pharmaceutical powders, liquid flow and dispersions
- To provide the knowledge about kinetics and drug stability

UNIT I MICROMERITICS AND POWDER RHEOLOGY 9

Particle size and distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, Dynamic light scattering (DLS) technique, measurement of particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.

UNIT II SURFACE AND INTERFACIAL PHENOMENON 9

Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, free energy, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interface, solid gas and solid-liquid interface, complex films, electrical properties of interface.

UNIT III VISCOSITY AND RHEOLOGY 9

Newtonian system, Law of flow, kinematic viscosity, effect of temperature on viscosity, non-Newtonian systems, plastic, pseudoplastic, dilatant, thixotropy, thixotropy in formulation, determination of viscosity: capillary, falling ball, rotational viscometers

UNIT IV DISPERSION SYSTEMS 9

Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy. Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspension, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicle, rheological considerations, emulsions; types, theories, physical stability.

UNIT V KINETICS AND DRUG STABILITY 9

General considerations and concepts of drug reaction kinetics; zero order, first order and pseudo first order, half-life determination, Influence of temperature, light, catalytic species, solvent and other factors, Stabilization of drugs, Accelerated stability study, expiration dating.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course the students will able to

CO1: Explain the methods used for determining particle size, particle volume and surface area along with the derived properties of powders

CO2: Differentiate the surface and interfacial phenomenon,

CO3: Distinguish between Newtonian and non-Newtonian system and to identify methods for determining viscosity.

CO4: Describe the types and properties of colloidal dispersions, suspensions and emulsions along with its applications

CO5: Acquire the knowledge of drug reaction kinetics, stabilization of drugs and its accelerated stability testing

CO6: Apply the knowledge of physical properties of powders, liquids, colloidal and coarse dispersions in the design of pharmaceutical dosage forms

TEXT BOOKS:

1. Manavalan, R. and Ramasamy. C. “Physical Pharmaceutics” 2nd Ed., Vignesh Publishers, 2015.
2. C.V.S. Subrahmanyam, Text book of physical pharmaceutics, 3rdEdn.,Vallabhprakashan, 2015.
3. Hadkar. U. B., Physical Pharmacy, NiraliPrakashan; 12th edition, 2017.

REFERENCES:

1. Alfred N. Martin, Patrick J. Sinko, Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, sixth edition, Lippincott Williams & Wilkins, 2011.
2. David B. Troy, Paul Beringer, Remington: The science and practice of pharmacy, 21st Edition,Lippincott Williams and Wilkins, 2006
3. Humphrey Moynihan and Abinacrean "Physicochemical Basis of Pharmaceuticals" Oxford University Press, 2009.

Course articulation matrix

Course outcome	PROGRAMME OUTCOMES (PO)												PROGRAMME SPECIFIC OUTCOMES (PSO)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1				1	1					1	2		1	1
CO2	3	1		1								1	1		3	1
CO3	3	1		1								1	1		3	1
CO4	3							1			1		2		2	1
CO5	3	1					1					1	3		2	
CO6	3	1			1							1	3		3	2
Average CO																

PROGRESS THROUGH KNOWLEDGE

PY3405 PHARMACEUTICAL ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To facilitate students to acquire knowledge about the principles and applications of pharmaceutical analysis.

UNIT I PROCESS ANALYTICAL TECHNOLOGY 9

On-line PAT Applications of Spectroscopy in the Pharmaceutical Industry: Reaction Monitoring - Crystallization - API Drying - Nanomilling - Hot-melt Extrusion – Granulation - Wet granulation - Roller compaction - Powder Blending - Lubrication - Powder flow - Compression – Coating - Biologics - Fermentation - Freeze-drying - Cleaning Validation.

UNIT II SAMPLE PREPARATION AND SPECIFIC METHODS 9

Strategies of sample preparation – liquid – liquid extraction, solid-liquid extraction – solid phase extraction techniques – radiometric analysis – Analysis of biological compounds – analysis of water.

UNIT III PHYSICAL ANALYTICAL METHODS 9

Solubility determination – Molecular weight determination – viscosity determination – Surface tension determination – Particle size analysis – X-ray diffraction – Polarimetery – refractometry.

UNIT IV CHEMICAL ANALYTICAL METHODS 9

Appearance, absorbance, pH, related substances, residual solvents, foreign anions, sulfated ash, elemental impurities, loss on drying, moisture and water, oxidizing substances, acid value, hydroxyl value, iodine value, peroxide value, saponification value, unsaponifiable matter – Functional group analysis

UNIT V CONTROL OF THE QUALITY OF ANALYTICAL METHODS 9

Control of errors in analysis – calibration methods - Accuracy and precision – validation of analytical procedures – SOPs – compound random errors – reporting of results – terms used in the control of analytical procedures – calculations in pharmaceutical analysis: percentage, dilutions, preparation of standard stock solutions, parts per million calculations – normality – molarity – molality – analytical standards – fundamentals of statistical analysis in pharmaceutical analysis.

SELF STUDY TOPICS (NOT FOR EXAMS)

Different types of biological analysis of pharmaceutical substances and dosage forms.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. highlight the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.
2. demonstrate the skills on various types of extraction techniques
3. develop skills on range of physical analytical methods
4. determine the chemical properties of pharmaceutical compound
5. control the errors in the analysis of drug sample
6. illustrate the methods used for quality control of drug samples.

TEXT BOOKS

1. Pharmaceutical Analysis P. D. Chaithanya Sudha, Pearson, 2013.
2. Pharmaceutical Drug Analysis, Ashutosh Kar. New Age international Pvt Ltd. 2005.
3. Siddiqui, Anees A. “Pharmaceutical Analysis”. Vol.I&II, CBS,2006
4. A.H. Beckett & J. B. Stenlake, “Practical Pharmaceutical Chemistry”, Part II, 4th Edition, Bloomsbury Academic, 2001.

REFERENCE BOOKS

1. Pharmaceutical Analysis A Textbook for Pharmacy Students and Pharmaceutical Chemists. Third Edition David G. Watson. Churchil Livingstone Elsevier. 2012.
2. Pharmaceutical Analysis for Small Molecules, First Edition. Edited by Behnam Davani. © 2017 John Wiley & Sons, Inc. Published 2017 by John Wiley & Sons, Inc.
3. Mendham J, "Vogel's Text Book of Quantitative Chemical Analysis", 6th Edition, Pearson Education 2009.
4. Process Analytical Technology: Spectroscopic Tools and Implementation Strategies for the Chemical and Pharmaceutical Industries, Second Edition Edited by Katherine A. Bakeev © 2010 John Wiley & Sons, Ltd. ISBN: 978-0-470-72207-7.
5. Introduction to Pharmaceutical Analytical Chemistry, Stig Pedersen-Bjergaard, BenteGammelgaard, Trine Grønhaug Halvorsen, Second Edition 2019, Wiley.

Course Articulation Matrix

Course Outcome	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3	PSO 4
CO1	3	3	2		3	2	2					2	3	-	2	
CO2	3	3	2		3	2	2				1	2	3	1	2	
CO3	3	3	2		3	2	2				1	2	3	1	2	
CO4	3	3	2		3	2	2				1	2	3	1	2	
CO5	3	1	1		3	2	2				1	2	3	1	2	
CO6	3	3	3		3	2	2				1	2	3	1	2	
AVERAGE CO	3	2.7	2	-	3	2	2	-	-	-	1	2	3	1	2	-

GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY **L T P C**
2 0 0 2

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, 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.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT III RENEWABLE SOURCES OF ENERGY . 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals,

and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL:30 PERIODS

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCE BOOKS :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 .
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. ErachBharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

PROGRESS THROUGH KNOWLEDGE

PY3411 PHARMACEUTICAL CHEMISTRY LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To provide students with the practical laboratory skills of pharmaceutical chemistry
- To demonstrate the effect of the different synthetic methodology.
- To clarify theoretical concepts of chemical synthesis of drug molecules.

LIST OF EXPERIMENTS

1. To determine the strength of a given unknown solution of HCl by titrating it against with the help of a known solution of NaOH using phenolphthalein indicator.
2. To determine the strength of a given unknown solution of NaOH by titrating it against with the help of a known solution of HCl using methyl orange indicator.

3. To prepare and standardize 200 ml of 0.1 M silver nitrate solution.
4. Determination of physical constants: melting point, boiling point, viscosity and pKa.
5. Determination of partition coefficient of any medicinal compound by shake flask method.
6. Preparation and identification tests of the following official (IP) compounds: Magnesium sulphate, Calcium Carbonate, Ferrous sulphate, Boric acid
7. Determination of impurities by limit test
8. Synthesis of compounds by hydrolysis reaction: Salicylic acid from Alkyl Benzoate.
9. Synthesis of compounds by oxidation reaction: Benzoic acid from Benzyl chloride.
10. Synthesis of compounds involving Electrophilic substitution reaction:
    Benzoylation: Benzanilide, Phenyl benzoate, 2-Naphthyl benzoate
    Acetylation: Aspirin
    Nitration: Picric acid, p-nitro aniline, m - dinitro benzene
    Halogenaion: p-bromo acetanilide
    Haloform: Iodoform
11. Synthesis of compounds by naming reaction: 7- hydroxy -4- methyl coumarin (Pechmann reaction), 1- phenyl azo-2-napthol (Diazotization and Coupling reaction)
12. Synthesis of major industrial compounds: Paracetamol from p-aminophenol, Benzocaine from p-nitro benzoic acid

TOTAL: 45PERIODS

LISTOFEQUIPMENTS REQUIRED FOR30STUDENTS

Vacuum filtrationunit
Refluxcondenser
Hotair oven
Waterbath
Distillationunit
Melting point apparatus
pH meter
Electronic Weighing balance
Heating Mantle
Vacuum dryer

Course outcomes:

The students will be able to

1. Apply safe laboratory practices in the preparation of reagents, handling and storage of chemicals.
2. Identify/confirm the unknown organic compounds by melting point determination, pKa, boiling point, Viscosity etc.
3. Carry out quality control tests for fine chemicals and bulk drugs.
4. Implement the knowledge of chemistry in designing the synthetic scheme of organic compounds.
5. Demonstrate feasible synthesis of some important class of drugs using chemical reactions.
6. Develop the reaction mechanism and orientation of chemical bonds in the synthesis of major industrial compounds.

REFERENCES:

1. K.Yogananda Reddy, Dr.K.N. Jayaveera & Dr.S.Subramanyam, Practical Medicinal Chemistry, S.Chan Publishing, 2013
2. Vogel's Textbook of Practical Organic Chemistry, 5th edition, Pearson Publisher, 2003.
3. Mann & Saunders, Practical Organic Chemistry, 4th edition, Pearson Publisher, 2009.
4. Chatwal G.R, “Pharmaceutical chemistry inorganic” Himalaya publishing house, Ed5th, 2010, pp 127-128.
5. N.M. Raghavendra &Sayan Dutta Gupta, Laboratory manual of Pharmaceutical Organic Chemistry- I, Vallabh Prakashan, 1st edition. 2013.

Course Articulation Matrix

Course outcome	Programme Outcome												Programme Specific outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3		2	2					2		2		2
CO2	3	1	2	2			1					2	2	2	3	3
CO3	3	1	2	2			1					2	3		3	2
CO4	3	1	2	2			1					2	3	3	2	
CO5	3	1	2	2			1					2			2	
CO6	3	3	3	3		2	2					2	3	2	2	2
Average CO	3	1.5	2.3	2.3		2	1					2	2.8	2.3	2.4	2.3

PY3412 PHYSICAL PHARMACEUTICS LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To practice the determination of fundamental properties of dosage forms of powders and dispersions.
- To study the kinetics and stability aspects of pharmaceuticals.

LIST OF EXPERIMENTS:

1. Determination of particle size, particle size distribution using various methods of particle size analysis.
2. Determination of surface area of powders.
3. Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
4. Determination of effect of glidant on angle of repose of powder
5. Determination of surface/interfacial tension, HLB value
6. Determination of critical micellar concentration (CMC) of surfactants.
7. Study of rheological properties of various types of systems using different viscometers.
8. Study of different types of colloids and their properties.
9. Preparation of various types of suspensions and determination of their sedimentation parameters.
10. Preparation and stability studies of emulsions.
11. Determination of half-life, rate constant and order of reaction.
12. Preparation of pharmaceutical buffers and determination of buffer capacity.
13. Determination of shelf life of a product based on Arrhenius principle

TOTAL:45 PERIODS

LIST OF EQUIPMENTS FOR BATCH OF 30 STUDENTS

- Optical Microscope-5no's
- Stage Micrometer-5no's
- Eye piece micrometer-5no's
- Stalagmometer-10no's
- Ostwald's Viscometer-10no's
- Brookfield viscometer-1no.
- Tapped density apparatus-3no's
- Andreason pipette-3no's
- Sieve shaker with sieve sets of different sizes-1no.

GLASSWARES REQUIRED

Pycnometer, Funnel, Beakers, Measuring cylinders,Dessicator,Mortar and pestle

COURSE OUTCOMES:

On completion of the course the students will able to

CO1 Characterize and evaluate the properties of powders by suitable methods

CO2 Plan and carryout the determination of interfacial property of liquids. .

CO3 Plan and carryout the determination of viscosity,

CO4 Plan and carryout the physical stability study of suspension and emulsion dosage forms..

CO5 Plan and carryout the, preparation of buffer and to determine the buffer capacity and isotonicity of solutions

CO6 Calculate the rate constant and order of reactions**.**

TEXT BOOKS:

1. C.V.S. Subrahmanyam, Physical pharmaceutics-I, 1st Edn., Vallabhprakashan,2019.
2. C.V.S. Subrahmanyam, Physical pharmaceutics - II, 1st Edn., Vallabhprakashan,2019.
3. Manavalan, R. and Ramasamy. C. "Physical Pharmaceutics" 2nd Ed., Vignesh Publishers, 2015.

REFERENCES:

1. Eugene L. Parrott, WitoldSaski, Experimental Pharmaceutics, 4thedn., Burgess Pub. Co., 1977.
2. C.V.S Subrahmanyam&J.ThimmaSetty, Laboratory Manual of Physical Pharmaceutics, 2nd Ed.,Vallabh Prakashan, 2014.
3. Dr. U. B. Hadkar, Practical Physical Pharmacy & Physical Pharmaceutics, NiraliPrakashan, Pune, 2008.

Course articulation matrix

Course outcome statement	Programme Outcome											Programme Specific outcome				
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O 3	PS O 4
CO1	3	3		2					1	1		1	3	1	2	
CO2	3	3		2					1	1		1	3	1	2	
CO3	3	3		2					1	1		1	3	1	2	
CO4	3	3		2					1	1		1	3	1	2	
CO5	3	3		2					1	1		1	3	1	2	
CO6	3	3		2					1	1		1	3	1	2	
Average CO	3	3		2					1	1		1	3	1	2	