

**Bachelor of Technology (Biotechnology), UIET, KUK
Credit-Based (2021-22 Onwards)**

SCHEME OF STUDIES/EXAMINATIONS (Semester-I)

(Common with earlier scheme of Semester-I B.Tech Biotechnology which was effective from session 2018-19)

S.No	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1A	BS-111	Applied Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105	Programming for Problem Solving	3:0:0	3	3	75	25	0	100	3
2B	HM-101	English	2:0:0	2	2	75	25	0	100	3
3	BS-131	Applied Mathematics-I	3:1:0	4	4	75	25	0	100	3
4A	ES-109	Engineering Graphics & Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111L	Manufacturing Processes Workshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101	Basic Electrical Engineering	4:1:0	5	5	75	25	0	100	3
6A	BS-113L	Applied Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103L	Chemistry Lab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107L	Programming for Problem Solving Lab	0:0:2	2	1	--	20	30	50	3
7B	ES-103L	Basic Electrical Engineering Lab	0:0:2	2	1	--	20	30	50	3
8A	ES-113L	Engineering Graphics & Design Practice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103L	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/25	21.0/ 20.0	375/ 300	185/ 200	90/ 150	650A/ 650B	

Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. Marked B in one particular semester. Induction Program (Three weeks duration) is a part of scheme of first year in I st semester for all branches

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SCHEME OF STUDIES/EXAMINATIONS (Semester-II)

(Common with earlier scheme of Semester-II B.Tech Biotechnology which was effective from session 2018-19)

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1A	BS-111	Applied Physics	3:1:0	4	4	75	25	0	100	3
1B	BS-101	Chemistry	3:1:0	4	4	75	25	0	100	3
2A	ES-105	Programming for Problem Solving	3:0:0	3	3	75	25	0	100	3
2B	HM-101	English	2:0:0	2	2	75	25	0	100	3
3	BS-132	Applied Mathematics-II	3:1:0	4	4	75	25	0	100	3
4A	ES-109	Engineering Graphics & Design	1:2:0	3	3	75	25	0	100	3
4B	ES-111L	Manufacturing Processes Workshop	0:0:3	3	1.5	-	40	60	100	3
5A	BS-141	Biology	2:1:0	3	3	75	25	0	100	3
5B	ES-101	Basic Electrical Engineering	4:1:0	5	5	75	25	0	100	3
6A	BS-113L	Applied Physics Lab	0:0:3	3	1.5	--	20	30	50	3
6B	BS-103L	Chemistry Lab	0:0:3	3	1.5	--	20	30	50	3
7A	ES-107L	Programming for Problem Solving Lab	0:0:2	2	1	--	20	30	50	3
7B	ES-103L	Basic Electrical Engineering Lab	0:0:2	2	1	--	20	30	50	3
8A	ES-113L	Engineering Graphics & Design Practice	0:0:3	3	1.5	--	20	30	50	3
8B	HM-103L	Language Lab	0:0:2	2	1	--	20	30	50	3
		Total	12:5:8/ 12:3:10	25/ 25	21.0/ 20.0	375/ 300	185/200	90/150	650A/ 650B	

- Note: (1)** A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. Marked B in one particular semester.
(2) All students have to undertake the industrial training for 4 to 6 weeks after 2nd semester which will be evaluated in 3rd semester.

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SCHEME OF STUDIES/EXAMINATIONS (Semester -III)

S.No	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	BTS-201	Biochemistry	3:0:0	3	3	75	25	0	100	3
2	BTS-203	Microbiology	2:0:0	2	2	75	25	0	100	3
3	BTS-205	Molecular Biology	3:0:0	3	3	75	25	0	100	3
4	BTS-207	Genetics and Cell Biology	3:0:0	3	3	75	25	0	100	3
5	BTS-211	Cell and Molecular Biology Lab	0:0:4	4	2		40	60	100	3
6	BTS-213	Biochemistry Lab	0:0:3	3	1.5	-	40	60	100	3
7	BTS-215	Microbiology Lab	0:0:3	3	1.5		40	60	100	3
8	PTS-201	Technical Seminar	0:0:2	2	1		100	0	100	3
9	HTM-901	Universal Human Values II : Understanding Harmony	3:0:0	3	3	75	25	0	100	3
10	PTS-203	Industrial Training-I	0:0:2	2	1		100	0	100	3
		Total	14:0:14	28	21.0	375	445	180	1000	

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SCHEME OF STUDIES/EXAMINATIONS (Semester -IV)

S.No	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	PTC-202	Industrial Biotechnology	2:0:0	2	2	75	25	0	100	3
2	PTC-204	Green Biotechnology and Pollution Abatement	2:0:0	2	2	75	25	0	100	3
3	PTC-206	Immunology and Advanced Diagnostic Techniques	2:1:0	3	3	75	25	0	100	3
4	PTC-208	Recombinant DNA Technology	2:1:0	3	3	75	25	0	100	3
5	BTS-202	Principles of Thermodynamics and Organic Chemistry	2:1:0	3	3	75	25	0	100	3
6	PTC-210	Industrial Biotechnology Lab	0:0:4	4	2		40	60	100	3
7	PTC-212	Immunology and Advanced Diagnostic Techniques Lab	0:0:2	2	1		40	60	100	3
8	PTC-214	Recombinant DNA Technology Lab	0:0:4	4	2	-	40	60	100	3
9	ATU-202*	Environmental Sciences	3:0:0	3		75	25		100	3
		Total	13:3:10	26	18	450	270	180	900	

*ATU-202 is a mandatory credit less course in which the student will be required to get passing marks in the major test.

Note: All the students have to undergo 4-6 weeks industrial training after IV semester and to be evaluated in V semester.

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SCHEME OF STUDIES/EXAMINATIONS (Semester -V)

S.No	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	PTC-301	Metabolic Engineering	2:0:0	2	2	75	25	0	100	3
2	PTC-303	Biophysical and Bioanalytical Techniques	2:0:0	2	2	75	25	0	100	3
3	PTC-305	Structural Biology	2:0:0	2	2	75	25	0	100	3
4	PTC-307	Bioprocess Engineering	2:0:0	2	2	75	25	0	100	3
5	PTC-309	Bioinformatics and Computational Biology	2:0:0	2	2	75	25	0	100	3
6	PTE-1*	Professional Elective-I	2:1:0	3	3	75	25	0	100	3
7	PTC-311	Bioinformatics and Computational Biology Lab	0:0:2	2	2		40	60	100	3
8	PTC-313	Biophysical and Bioanalytical Techniques Lab	0:0:3	3	1.5		40	60	100	3
9	PTC-315	Metabolic Engineering Lab	0:0:3	3	1.5	-	40	60	100	3
10	OTS-1**	Open Subject-I	2:0:0	2	2	75	25		100	3
11	ATU-301	Indian Constitution	2:0:0	2	2	75	25		100	3
12	PTS-301	Industrial Training	0:0:2	2	1		100		100	3
13	**ATU-903	Essence of Indian Traditional Knowledge	3:0:0	3		100	-	-	100	3
		Total	19:1:10	30	23	700	420	180	1300	

****ATU-903** is a mandatory credit less course in which the student will be required to get passing marks in the major test.

Professional Elective-I*

PTE-301 Good Manufacturing and Lab Practices
PTE-303 Genome Editing
PTE-305 Biochemical and Enzyme Technology
PTE-307 Bioreactor Analysis and Design

Open Subject- I**

OTS-301 Biomaterial Technology
OTS-303 Internet of Things
OTS-305 Image Processing/MOOC Course
OTS-307 3D Printing & Design /MOOC Course`

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SCHEME OF STUDIES/EXAMINATIONS (Semester -VI)

S.No	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	PTC-302	Downstream Processing and Bioseparation Engineering	3:1:0	4	4	75	25	0	100	3
2	PTC-304	Synthetic and Systems Biology	2:1:0	3	3	75	25	0	100	3
3	PTC-306	Animal and Plant Biotechnology	2:1:0	3	3	75	25	0	100	3
4	PTC-308	Data Science in Genome Technology	3:0:0	3	3	75	25	0	100	3
5	PTE-II*	Professional Elective-II	2:1:0	3	3	75	25	0	100	3
6	OTS-II**	Open Subject-II	2:0:0	2	2	75	25	0	100	3
7	PTC-308	Data Science in Genome Technology Lab	0:0:2	2	1		40	60	100	3
8	PTC-310	Downstream Processing Lab	0:0:2	2	1		40	60	100	3
9	PTC-312	Animal and Plant Biotechnology Lab	0:0:4	4	2		40	60	100	3
10	PTS-302	Technical Seminar	0:0:2	2	1	-	100	0	100	3
11	HSMC-1	Elective-1***	3;0:0	3	3	75	25	0	100	3
		Total	17:4:10	31	26	525	395	180	1100	

Students shall have to select one elective from each group of Program Elective-II, Open Subjects-II and HSMC Elective-1.

Professional Elective-II*

PTE-302 Machine Learning
PTE-304 Waste Management and Upcycling
PTE-306 Stem Cell Technology
PTE-308 Nanobiotechnology

Open Subject- II**

OTS-302 Artificial Intelligence
OTS-304 Quantum Computing/MOOC Course
OTS-306 Cyber Security /MOOC Course
OTS-308 Design Thinking

HSMC Elective-1***

HSMC-301 Engineering Economics
HSMC-302 Management-1 (Organizational Behaviour)
HSMC-303 Operations Research
HSMC-304 Effective Technical Communication

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SCHEME OF STUDIES/EXAMINATIONS (Semester -VII)

S.No	Course No./Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	PTC-401	Food and Nutrition Biology	2:0:0	2	2	75	25	0	100	3
2	PTC-403	Artificial Intelligence in Affordable Healthcare	2:0:0	2	2	75	25	0	100	3
3	PTE-III	Program Elective-III*	2:1:0	3	3	75	25	0	100	3
4	PTE-IV	Program Elective-IV*	2:1:0	3	3	75	25	0	100	3
5	OTS-III	Open Subject-III**	2:0:0	2	2	75	25	0	100	3
6	OTS-IV	Open Subject-IV**	2:0:0	2	2	75	25	0	100	3
7	HSMC-II	Elective-II***	3:0:0	3	3	75	25	0	100	3
8	PTC-405	Food and Nutrition Biology Lab	0:0:2	2	1	-	40	60	100	3
9	PTS-401	Project-I	0:0:4	4	2		40	60	100	3
10	PTS-403	Industrial Training	2:0:0	2	2		100		100	3
		Total	17:2:6	25	22	525	355	120	1000	

Students shall have to select one elective from each group of Program Elective-III/IV, Open Subjects-III/IV and HSMC Elective-II.

Program Elective-III*

PTE-401 Gene Expression and Transgenics
PTE-403 Essentials of Virology
PTE-405 Tissue Engineering
PTE-407 Biostatistics

Program Elective-IV*

PTE-409 Quality Control Management in Biotechnology
PTE-411 Biosensors & Bioinstrumentation
PTE-413 Biomedical Engineering
PTE-415 Omics Technology

Open Subject-III**

OTS-401 Robotics
OTS-403 Virtual Reality
OTS-405 Plant Biology
OTS-407 MOOC Course

Open Subject-IV**

OTS-409 Bioterrorism and National Security
OTS-411 Biosimilar Technology
OTS-413 Comparative and Functional Genomics
OTS-415 MOOC Course

HSMC Elective-II***

HSMC-401 Introduction to Industrial Management
HSMC-402 Industrial Psychology
HSMC-403 Innovation, Startups & Entrepreneurship
HSMC-404 Intellectual Property Rights (IPR) & Regulatory

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SCHEME OF STUDIES/EXAMINATIONS (Semester -VIII)

S.No	Course No./Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	PTS-402	Project-II	0:0:12	18	9		40	60	100	3
		Total	0:0:12	18	9		40	60	100	

Students opting for B.Tech. (HONS.) Biotechnology with minor specialization in Computational Biology, Drug Engineering, Genome Engineering and Technology, Artificial Intelligence & Machine Learning, Blockchain, Data Science, Internet of Things, Cyber Security, 3D Printing, Energy Engineering and Robotics shall have to earn 18 to 20 extra credits from the subjects mentioned in the annexures besides completing 160 credits of regular B.Tech. Biotechnology degree. The subjects mentioned in the annexures may be covered from MOOCs/SWAYAM portal.

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Nomenclature for B.TECH. Degree in Emerging Areas of Biotechnology

1. B. Tech. (Hons.) Biotechnology with Specialization in Computer Science and Biology
2. B. Tech. (Hons.) Biotechnology with Specialization in Drug Engineering
3. B. Tech. (Hons.) Biotechnology with Specialization in Genome Engineering & Technology
4. B. Tech. Biotechnology with Minor Degree in Artificial Intelligence & Machine Learning
5. B. Tech. Biotechnology with Minor Degree in Blockchain
6. B. Tech. Biotechnology with Minor Degree in Data Science
7. B. Tech. Biotechnology with Minor Degree in Internet of Things
8. B. Tech. Biotechnology with Minor Degree in Cyber Security
9. B. Tech. Biotechnology with Minor Degree in 3D Printing
10. B. Tech. Biotechnology with Minor Degree in Electrical Vehicle
11. B. Tech. Biotechnology with Minor Degree in Energy Engineering
12. B. Tech. Biotechnology with Minor Degree in Mechatronics
13. B. Tech. Biotechnology with Minor Degree in Robotics.

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Table 1: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Artificial Intelligence and Machine Learning

Artificial Intelligence and Machine Learning (Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/AI-1	Artificial Intelligence : Search Methods For Problem solving
	SPMD/AI-2	OR An Introduction to Artificial Intelligence
2.	SPMD/AI-3	Artificial Intelligence: Knowledge Representation and Reasoning
3.	SPMD/AI-4	Programming, Data Structures and Algorithms in Python
	SPMD/AI-5	OR Python for Data Science
4.	SPMD/AI-6	Introduction to Machine Learning
5.	SPMD/AI-7	Deep Learning
	SPMD/AI-8	OR Deep Learning for Computer Vision
6.	SPMD/AI-9	Reinforcement Learning
7.	SPMD/AI-10	AI: Constraint Satisfaction
8.	SPMD/AI-11	Computer Vision
9.	SPMD/AI-12	Natural Language Processing
	SPMD/AI-13	OR Applied Natural Language Processing
10.	SPMD/AI-14	Practical Machine Learning with Tensorflow
11.	SPMD/AI-15	Introduction to Data Analytics
	SPMD/AI-16	OR Data Science for Engineers
12.	SPMD/AI-17	Learning Analytics Tools
13.	SPMD-1	Design Thinking - A Primer
14.	SPMD-2	Ethics in Engineering Practice

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Table 2: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Internet of Things (IoT)

Internet of Things (IoT)		
(Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/IoT-1	Introduction to Industry 4.0 and Industrial Internet of Things
	SPMD/IoT-2	OR Introduction to Internet of Things
2.	SPMD/IoT-3	Electronic Systems for Sensor Applications
3.	SPMD/IoT-4	Optical Fiber Sensors
	SPMD/IoT-5	OR Optical Sensors
4.	SPMD/IoT-6	Introduction to Machine Learning
5.	SPMD/IoT-7	Selection of Nanomaterials for Energy Harvesting and Storage Application
6.	SPMD/IoT-8	Python for Data Science
7.	SPMD/IoT-9	Deep Learning
	SPMD/IoT-10	OR Deep Learning for Computer Vision
8.	SPMD/IoT-11	Reinforcement Learning
9.	SPMD/IoT-12	Cloud computing
	SPMD/IoT-13	OR Google Cloud Computing Foundations
10.	SPMD/IoT-14	Modern Application Development
11.	SPMD/IoT-15	Introduction to Data Analytics
	SPMD/IoT-16	OR Data Science for Engineers
12.	SPMD/IoT-17	Computer Networks and Internet Protocol
13.	SPMD/IoT-18	Introduction to Database Systems
14.	SPMD-1	Design Thinking – A Primer
15.	SPMD-2	Ethics in Engineering Practice

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Table 3: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Blockchain

Blockchain		
(Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/BL-1	Introduction to Blockchain Technology and Applications
	SPMD/BL-2	OR Blockchain Architecture Design and Use Cases
2.	SPMD/BL-3	Introduction to Internet of Things
3.	SPMD/BL-4	Information Security – 5 – Secure Systems Engineering
4.	SPMD/BL-5	Introduction to Machine Learning
5.	SPMD/BL-6	Ethical Hacking
6.	SPMD/BL-7	GPU Architectures and Programming
7.	SPMD/BL-8	Computer Networks and Internet Protocol
8.	SPMD/BL-9	Cloud computing
	SPMD/BL-10	OR Google Cloud Computing Foundations
9.	SPMD/BL-11	Foundations of Cryptography
10.	SPMD/BL-12	Information Theory and Coding
11.	SPMD/BL-13	Introduction to Database Systems
12.	SPMD/BL-14	Internetwork Security
13.	SPMD-1	Design Thinking – A Primer
14.	SPMD-2	Ethics in Engineering Practice

Robotics		
(Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/RB-1	Foundations of Cognitive Robotics
2.	SPMD/RB-2	Introduction to Robotics
	SPMD/RB-3	OR Robotics
3.	SPMD/RB-4	Mechanism and Robot Kinematics
4.	SPMD/RB-5	Computer Architecture and Organization
5.	SPMD/RB-6	Power Electronics
6.	SPMD/RB-7	Principle of Hydraulic Machines and System Design
7.	SPMD/RB-8	Programming, Data Structures and Algorithms Using Python
8.	SPMD/RB-9	Control Systems
9.	SPMD/RB-10	Fundamentals of Artificial Intelligence
10.	SPMD/RB-11	Introduction to Machine Learning

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11.	SPMD/RB-12	Dynamical System and Control
12.	SPMD/RB-13	Introduction to Embedded System Design
13.	SPMD/RB-14	Introduction to Internet of Things
	SPMD/RB-15	OR Introduction to Industry 4.0 and Industrial Internet of Things
14.	SPMD-1	Design Thinking – A Primer
15.	SPMD-2	Ethics in Engineering Practice

Table 4: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Data Science

Data Science (Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/DS-1	Python for Data Science
	SPMD/DS-2	OR Programming, Data Structures and Algorithms in Python
2.	SPMD/DS-3	Introduction to Data Analytics
	SPMD/DS-4	OR Data Science for Engineers
3.	SPMD/DS-5	Programming, Data Structures and Algorithms in Python
	SPMD/DS-6	OR Python for Data Science
4.	SPMD/DS-7	Introduction to Machine Learning
5.	SPMD/DS-8	Deep Learning
	SPMD/DS-9	OR Deep Learning for Computer Vision
6.	SPMD/DS-10	Reinforcement Learning
7.	SPMD/DS-11	Artificial Intelligence : Search Methods For Problem solving
	SPMD/DS-12	OR An Introduction to Artificial Intelligence
8.	SPMD/DS-13	Artificial Intelligence: Knowledge Representation and Reasoning
9.	SPMD/DS-14	Computer Vision
10.	SPMD/DS-15	Natural Language Processing
	SPMD/DS-16	OR Applied Natural Language Processing
11.	SPMD/DS-17	Practical Machine Learning with Tensorflow
12.	SPMD/DS-18	Learning Analytics Tools
13.	SPMD-1	Design Thinking – A Primer
14.	SPMD-2	Ethics in Engineering Practice

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Table 5: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Cyber Security

Cyber Security (Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/CS-1	Cryptography And Network Security
2.	SPMD/CS-2	Ethical Hacking
3.	SPMD/CS-3	Information Security – 5 – Secure Systems Engineering
4.	SPMD/CS-4	Privacy and Security in Online Social Media
5.	SPMD/CS-5	Information Theory and Coding
6.	SPMD/CS-6	Introduction to Information Security
7.	SPMD/CS-7	Introduction to Cryptology
8.	SPMD/CS-8	Computational Number Theory & Cryptography
9.	SPMD/CS-9	Hardware Security
10.	SPMD/CS-10	Internetwork Security
11.	SPMD/CS-11	Introduction to Machine Learning
12.	SPMD/CS-12	Introduction to Internet of Things
13.	SPMD-1	Design Thinking – A Primer
14.	SPMD-2	Ethics in Engineering Practice

Table 6: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in 3D Printing

3D Printing (Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/3D-1	Rapid Manufacturing
2.	SPMD/3D-2	Electronics Equipment Integration and Prototype Building
3.	SPMD/3D-3	Product Design and Development
4.	SPMD/3D-4	The Future of Manufacturing Business: Role of Additive Manufacturing
5.	SPMD/3D-5	Functional and Conceptual Design
6.	SPMD/3D-6	Introduction to Polymer Science
7.	SPMD/3D-7	Innovation by Design
8.	SPMD/3D-8	Design, Technology and Innovation
9.	SPMD-1	Design Thinking – A Primer
10.	SPMD-2	Ethics in Engineering Practice

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Table 7: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Electric Vehicles

Electric Vehicles		
(Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/EV-1	Fundamentals of Electric Vehicles: Technology & Economics
2.	SPMD/EV-2	Fundamentals of Electrical Engineering
3.	SPMD/EV-3	Electrical Machines
4.	SPMD/EV-4	Physics of Materials
	SPMD/EV-5	OR Powder Metallurgy
5.	SPMD/EV-6	Introduction to CFD
6.	SPMD/EV-7	Structural Analysis of Nanomaterials
7.	SPMD/EV-8	Ecology and Environment
8.	SPMD/EV-9	Dynamic Behavior of Materials
9.	SPMD/EV-10	Welding of Advanced High Strength Steels for Automotive Applications
10.	SPMD/EV-11	Dynamical System and Control
11.	SPMD-1	Design Thinking - A Primer
12.	SPMD-2	Ethics in Engineering Practice

Table 8: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Energy Engineering

Energy Engineering		
(Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/EE-1	Fundamentals of Conduction and Radiation
	SPMD/EE-2	OR Fundamentals of Convective Heat Transfer
2.	SPMD/EE-3	Energy Conservation and Waste Heat Recovery
3.	SPMD/EE-4	Ecology and Environment
4.	SPMD/EE-5	Energy Economics and Policy
5.	SPMD/EE-6	Bioenergy
	SPMD/EE-7	OR Waste to Energy Conversion
6.	SPMD/EE-8	Non-Conventional Energy Resources
	SPMD/EE-9	OR Technologies for Clean and Renewable Energy Production
7.	SPMD/EE-10	Selection of Nanomaterials for Energy Harvesting and Storage Application
8.	SPMD/EE-11	Solar Energy Engineering and Technology
9.	SPMD-1	Design Thinking - A Primer
10.	SPMD-2	Ethics in Engineering Practice

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Table 9: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Mechatronics

Mechatronics		
(Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/ME-1	Power Electronics
2.	SPMD/ME-2	Semiconductor Optoelectronics
	SPMD/ME-3	OR Semiconductor Devices and Circuits
3.	SPMD/ME-4	Digital Circuits
4.	SPMD/ME-5	Analog Electronic Circuits
5.	SPMD/ME-6	Control Systems
	SPMD/ME-7	OR Control Engineering
6.	SPMD/ME-8	Introduction to Internet of Things
7.	SPMD/ME-9	Introduction to Fuzzy Set Theory, Arithmetic and Logic
	SPMD/ME-10	OR Switching Circuits and Logic Design
8.	SPMD/ME-11	Microcontrollers and Applications
9.	SPMD/ME-12	Introduction to Embedded System Design
10.	SPMD/ME-13	Introduction to Robotic
11.	SPMD/ME-14	Optical Fiber Sensors
12.	SPMD/ME-15	Automation in Manufacturing
13.	SPMD-1	Design Thinking - A Primer
14.	SPMD-2	Ethics in Engineering Practice

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Table 10: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Computer Science and Biology

Computer Science and Biology		
(Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/CB-1	Computational Systems Biology
2.	SPMD/CB-2	Introduction to Database Systems
3.	SPMD/CB-3	Introduction to Artificial Intelligence
	SPMD/CB-4	OR Artificial Intelligence Search Methods for Problem Solving
4.	SPMD/CB-5	Image Signal Processing
5.	SPMD/CB-6	Introduction to Internet of Things
6.	SPMD/CB-7	Introduction to Computer Graphics
	SPMD/CB-8	OR Computer Graphics
7.	SPMD/CB-9	MATLAB Programming for Numerical Computation
8.	SPMD/CB-10	Programming, Data Structures and Algorithms in Python
9.	SPMD/CB-11	Introduction to Machine Learning
10.	SPMD/CB-12	Data Mining
11.	SPMD/CB-13	Introduction to Dynamical Models in Biology
12.	SPMD/CB-14	Biometrics
13.	SPMD/CB-15	BioInformatics: Algorithms and Applications
14.	SPMD/CB-16	Introduction to Proteogenomics
15.	SPMD/CB-17	Foundations of Cryptography
16.	SPMD/CB-18	Modern Application Development
17.	SPMD/CB-19	Ethical Hacking
18.	SPMD/CB-20	Computer Aided Drug Design
19.	SPMD/CB-21	Functional Genomics
20.	SPMD-1	Design Thinking - A Primer
21.	SPMD-2	Ethics in Engineering Practice

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Table 11: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Drug Engineering

Drug Engineering (Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/DE-1	Drug Delivery: Principles and Engineering
2.	SPMD/DE-2	Experimental Biotechnology
3.	SPMD/DE-3	Spectroscopic Techniques for Pharmaceutical and Biopharmaceutical Industries
4.	SPMD/DE-4	Environmental Quality Monitoring & Analysis
5.	SPMD/DE-5	Computer Aided Drug Design
6.	SPMD/DE-6	Current Regulatory Requirements for Conducting Clinical Trials in India for Investigational New Drugs/New Drug
7.	SPMD/DE-7	Introduction to Dynamical Models in Biology
8.	SPMD/DE-8	Medical Biomaterials
9.	SPMD/DE-9	Metals in Biology
10.	SPMD/DE-10	Gene Therapy
11.	SPMD/DE-11	Introduction to Cardiovascular Fluid Mechanics
12.	SPMD/DE-12	Optical Sensors
13.	SPMD/DE-13	Nano Structured Materials- Synthesis, Properties, Self-assembly and Applications
14.	SPMD/DE-14	Transport Phenomena in Biological Systems
15.	SPMD/DE-15	Aspects of Biochemical Engineering
16.	SPMD/DE-16	Process Control Design, Analysis and Assessment
17.	SPMD/DE-17	Industrial Biotechnology
18.	SPMD/DE-18	Interactomics
19.	SPMD/DE-19	Health Research Fundamentals
20.	SPMD/DE-20	Computational Systems Biology
21.	SPMD/DE-21	Human Molecular Genetics
22.	SPMD-1	Design Thinking - A Primer
23.	SPMD-2	Ethics in Engineering Practice

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Table 12: List of elective subjects for acquiring additional 18-20 credits for B.Tech (Hons.) with Specialization/Minor Degree in Genome Engineering & Technology

Genome Engineering & Technology		
(Minimum credits to be earned are EIGHTEEN-TWENTY)		
<i>Note: Credit of the subject/s which are counted for earning 160 credits of the degree will not be counted for acquiring Hons. with Specialization/Minor Degree.</i>		
Sr. No.	Code	Subject Nomenclature
1.	SPMD/GE-1	Introduction to Proteogenomics
2.	SPMD/GE-2	Interactomics: Basics & Applications
3.	SPMD/GE-3	Drug Delivery: Principles and Engineering
4.	SPMD/GE-4	Experimental Biotechnology
5.	SPMD/GE-5	Bioengineering: An Interface with Biology and Medicine
6.	SPMD/GE-6	Functional Genomics
7.	SPMD/GE-7	Protein and Gel Based Proteomics
8.	SPMD/GE-8	Cell Culture Technologies
9.	SPMD/GE-9	Tissue Engineering
10.	SPMD/GE-10	Biomedical Nanotechnology
11.	SPMD/GE-11	Introductory Mathematical Methods for Biologists
12.	SPMD/GE-12	Nanotechnology in Agriculture
13.	SPMD/GE-13	Introduction to Proteomics
14.	SPMD/GE-14	Applications of Interactomics using Genomics and Proteomics Technologies
15.	SPMD/GE-15	Transport Phenomena in Biological Systems
16.	SPMD/GE-16	Proteomics and Genomics
17.	SPMD/GE-17	Medical Biomaterials
18.	SPMD/GE-18	Thermodynamics for Biological Systems: Classical and Statistical Aspect
19.	SPMD/GE-19	Mass Spectrometry Based Proteomics
20.	SPMD/GE-20	Advanced Clinical Proteomics
21.	SPMD/GE-21	Application of Spectroscopic Methods in Molecular Structure Determination
22.	SPMD/GE-22	Gene Therapy
23.	SPMD-1	Design Thinking - A Primer
24.	SPMD-2	Ethics in Engineering Practice

BS-111	Applied Physics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h
Purpose	To introduce the basics of physics to the students for applications in Engineering field.						
Course Outcomes							
CO 1	Introduce the fundamentals of interference and diffraction and their applications.						
CO 2	To make the students aware of the importance of polarization and Laser in technology.						
CO 3	Applications of optical fiber and ultrasonics in various fields.						
CO 4	Introduce the nuclear radiations and its biological effects.						

Unit - I

Interference: Principle of Superposition, Conditions for interference, Division of wave-front: Fresnel's Biprism and Applications, Division of amplitude: Wedge-shaped film, Newton's rings, Michelson Interferometer and Applications.

Diffraction: Types of diffraction, Fraunhofer diffraction at a single slit, Plane transmission diffraction grating: theory, secondary maxima and minima, width of principal maxima, absent spectra, overlapping of spectral lines, determination of wavelength; Dispersive power and resolving power of diffraction grating.

Unit – II

Polarization: Polarization of transverse waves, Plane of polarization, Polarization by reflection, Double refraction, Nicol Prism, Quarter and half wave plate, Specific Rotation, Laurent 's half shade polarimeter, Biquartzpolarimeter.

Laser: Introduction, Stimulated Absorption, Spontaneous and Stimulated Emission; Einstein's Coefficients and its derivation, Population Inversion, Direct and Indirect pumping, Pumping schemes, Main components of Laser, He-Ne Laser, Semiconductor Laser, Characteristics of Laser, Applications of Laser.

Unit – III

Optical Fiber: Introduction, Principle of propagation of light waves in optical fibers: total internal reflection, acceptance angle, numerical aperture, V- number; Modes of propagation, Types of optical fibers: single mode fiber, multimode fibers; Fiber optics communication system, Advantages of optical fiber communication, Applications of optical fibers.

Ultrasonics: Ultrasonic waves, Properties of ultrasonic waves, Production of ultrasonic waves: Magnetostriction and Piezoelectric methods, Detection of ultrasonic waves, Measurement of velocity of ultrasonic waves, Applications of ultrasonic waves.

Unit – IV

Nuclear radiations and its Biological Effects: Classification of nuclear radiations, Interaction of charged particle (light and heavy) and gamma radiations with matter (basic concepts), Dosimetric units, Relative Biological Effectiveness (RBE), Typical doses from commons sources in the environment, Biological Effects, Maximum Permissible Dose, (MPD), Shielding, Radiation safety in the nuclear radiation laboratory.

Biomaterials: Introduction, Classification of biomaterials, Applications.

Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
3. A Textbook of Optics, S. Chand & Company Ltd.
4. Techniques for Nuclear and Particle Physics Experiments: A How-to Approach, Springer-Verlag.
5. Introduction to Nuclear and Particle Physics, PHI Learning Private Limited.
6. Biomaterials: The intersection of Biology and Materials Science, Pearson, New Delhi.

Note: The paper setter will set the paper as per the question paper templates provided.

BS- 113L		Applied Physics Lab					
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h
Purpose		Give the knowledge of basic practicals of Physics in Engineering.					
Course Outcomes							
CO1	To make the students familiar with the experiments related with optics.						
CO2	To give the knowledge of handling of the experiments related with resistance using different methods.						

Note: Student will be required to perform at least 10 experiments out of the following list.

- To verify Newton's formula and hence to find the focal length of the given convex lens.
- To find the frequency of A.C. mains by using Sonometer and horse shoe magnet.
- To find the resistance of a galvanometer by post office box.
- To find low resistance by Carrey-Foster bridge.
- To find the value of high resistance by substitution method.
- To compare the capacitances of two capacitors by De-Sauty's bridge and hence to find the dielectric constant of a medium.
- To convert a galvanometer into an ammeter of desired range and verify the same.
- To find the wavelength of monochromatic light by Newton's ring experiment.
- To find the wavelength of sodium light by Michelson's interferometer.
- To find the resolving power of telescope.
- To find the wavelength of sodium light using Fresnel bi-prism.
- To find the wavelength of various colours of white light with the help of plane transmission diffraction grating.
- To find the specific rotation of sugar solution by using a Polarimeter.

Suggested Books:

- C.L.Arora, B. Sc. Practical Physics, S. Chand.
- B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
- S.L. Gupta & V. Kumar, Practical Physics, Pragati Prakashan.

BS-101		Chemistry					
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h
Purpose	To familiarize the students with basic and applied concept in chemistry						
CO1	An insight into the atomic and molecular structure						
CO2	Analytical techniques used in identification of molecules						
CO3	To understand Periodic properties						
CO4	To understand the spatial arrangement of molecules						

UNIT - I

Atomic and molecular structure (10 lectures)

Molecular orbitals of diatomic molecules (N₂, O₂, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of [Co(NH₃)₆], [Ni(CO)₄], [PtCl₂(NH₃)₂] and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria (4 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications.

Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H₂O, NH₃, PCl₅, SF₆, CCl₄, Pt(NH₃)₂Cl₂)

UNIT - IV

Stereochemistry (6 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

Suggested Books:

- 1) University chemistry, by B. M. Mahan, Pearson Education
- 2) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
- 3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
- 4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
- 5) Physical Chemistry, by P. W. Atkins
- 6) Organic Chemistry: Structure and Function by K. P. C. Vollhardt and N. E. Schore, 5th Edition <http://bcs.whfreeman.com/vollhardtschore5e/default.asp>

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103L	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3h

LIST OF EXPERIMENTS

- To Determine the surface tension of a given liquid
- To determine the relative viscosity of a given liquid using Ostwald's viscometer
- To identify the number of components present in a given organic mixture by thin layer chromatography
- To determine the alkalinity of a given water sample
- Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
- Synthesis of a drug (paracetamol/Aspirin)
- Determination of chloride content of a given water sample
- To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
- To determine the total iron content present in a given iron ore solution by redox titration
- Determination of the partition coefficient of a substance between two immiscible liquids
- To find out the content of sodium, potassium in a given salt solution by Flame Photometer
- To find out the λ_{max} and concentration of unknown solution by a spectrophotometer
- To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
- To determine the amount of dissolved oxygen present in a given water sample
- To find out the pour point and cloud point of a lubricating oil
- Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
- Using Redwood Viscometer find out the viscosity of an oil sample

Note: Atleast 9 experiments to be performed from the list.

ES-105 Programming for Problem Solving							
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h
Purpose To familiarize the students with the basics of Computer System and C Programming							
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union. Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. Subrata Saha, Subhodip Mukherjee: Basic Computation & Programming with 'C' - Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
- E Balagurusamy : Programming in ANSI C, TMH Education.
4. Pradip Dey and Manas Ghose, "Computer Fundamental and Programming in C", Oxford Pub.
5. Forouzan Behrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
6. 7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. Yashwant Kanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" Dhanpat Rai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107L	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

HM-101		English					
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3h
Course Outcomes							
CO 1	Building up the vocabulary						
CO 2	Students will acquire basic proficiency in English including writing skills						

UNIT- 1

Vocabulary Building

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

UNIT- 2

Basic Writing Skills

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

UNIT- 3

Identifying Common Errors in Writing

- 3.1 Subject-verb agreement
- 3.2 Noun-pronoun agreement
- 3.3 Misplaced modifiers
- 3.4 Articles
- 3.5 Prepositions
- 3.6 Redundancies
- 3.7 Clichés

UNIT-4

Nature and Style of sensible Writing

- 4.1 Describing
- 4.2 Defining
- 4.3 Classifying
- 4.4 Providing examples or evidence
- 4.5 Writing introduction and conclusion
- 4.6 Comprehension
- 4.7 Précis Writing
- 4.8 Essay Writing

Suggested Books:

- (i) Practical English Usage. Michael Swan. OUP. 1995.
- (ii) Remedial English Grammar. F.T. Wood. Macmillan. 2007 (iii) On Writing Well. William Zinsser. Harper Resource Book. 2001
- (iii) Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006
- (iv) Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
- (v) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

HM-103L	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3h

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

BS-131		APPLIED MATHEMATICS-I					
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 h
Purpose	The objective of this course is to familiarize the prospective Biotechnology Engineers with techniques in Limit, Continuity, Differential & Integral Calculus and Complex Numbers. It aims to equip the students with standard concepts and tools at a beginner to intermediate and then at advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the objectives are as under:						
Course Outcomes							
CO1	To introduce the idea of sets, relations, functions, trigonometric functions, inverse trigonometric functions, these concepts are prerequisite to learn the concepts of differentiation and integration.						
CO 2	To introduce the Complex numbers which is fundamental to solve any kind of quadratic equations, Limit is precondition to understand the concept of rate of change and derivative.						
CO 3	To develop the essential tool of Continuity and Differentiability needed in evaluating higher order derivatives of functions.						
CO 4	To introduce the tools of Indefinite and Definite integrals of functions in a comprehensive manner that are used in various techniques dealing engineering problems.						

UNIT-I

(12 hrs)

Sets, Relations, Functions

Sets and its types: Operations on sets, complement of a set, Cartesian Product of sets, relations, functions, types of functions, **Trigonometric functions:** Introduction, Angles, Trigonometric functions, Trigonometric functions of sum and difference of two angles, Trigonometric equations, **Inverse Trigonometric functions:** Introduction, basic concepts and its properties.

UNIT-II

(12 hrs)

Pre-Calculus

Complex Numbers: Introduction, Algebra of Complex Numbers, Modulus and the conjugate of a complex number, quadratic equations, **Limits and Derivatives:** Introduction, Limits, Limits of Trigonometric Functions, Derivatives (single variable).

UNIT-III

(12 hrs)

Differential Calculus

Continuity and Differentiability: Introduction, Continuity, Differentiability, Exponential and Logarithmic functions, Logarithmic differentiation, Derivatives of functions in parametric forms, second order derivatives, **Application of Derivatives (single variable):** Increasing and decreasing functions, Maxima and Minima.

UNIT-IV

(12 hrs)

Integral Calculus

Integrals: Introduction, Integration as an Inverse process of Differentiation, Method of Integration, Integration by Partial Fractions, Integration by Parts, **Definite Integrals:** Fundamental theorem of Calculus, Evaluation of Definite Integrals by Substitution, properties of Definite Integrals.

Suggested Books:

1. G. B. Thomas, R. L. Finney: Calculus and Analytic Geometry, Pearson Education.
2. Mathematics Textbook for Class 11th& 12th by NCERT.
3. Howard Anton: Calculus, Wiley Publication.
4. E. Kreyszig: Advanced Engineering Mathematics, Wiley India.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-132	APPLIED MATHEMATICS-II						
L	T	P	Credit	Major Test	Minor Test	Total	Time
4	1	-	4.5	75	25	100	3 h
Purpose	The objective of this course is to familiarize the prospective Biotechnology Engineers with techniques in essential tool of linear algebra, how to solve a differential equation, utility of higher order derivatives in engineering domain, and fitting of a curve to given data. It aims to equip the students with standard concepts and tools at a beginner to intermediate and then at advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the objectives are as under:						
Course Outcomes							
CO1	To introduce the essential tool of matrices and linear algebra in a comprehensive manner to solve the large system of linear equations.						
CO 2	To introduce the statistical process used for estimating the parameters of a given curve or function to fit to a given data set using various degrees and types of curve fitting techniques.						
CO 3	To introduce effective mathematical tools for the solutions of differential equations that model physical processes.						
CO 4	To extend some concept of differential calculus for more than one variables.						

UNIT-I

(10 Hrs)

Linear Algebra:

Introduction to matrices, its types, algebraic operations, transpose, determinant, minors and adjoint of a matrix. Elementary transformations, Inverse of a square matrix: Cramer's rule, Rank of a matrix, elementary matrices, Gauss Jordan method to find inverse using elementary transformations.

System of Linear equations: General representation, Homogeneous and Non-homogeneous system of linear equations, Consistency of linear system of equations, Gauss Elimination method to solve the system of linear equations.

UNIT-II

(12 Hrs)

Theory of Equations:

Introduction, formation of equations, Relation between roots and coefficients, Reciprocal Equations, Transformation of equations.

Curve Fitting:

Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form $y \propto ax^b$, fitting of an exponential curve of the form $Y = ab^x$.

UNIT-III

(10 hrs)

Ordinary differential equations:

Introduction, order and degree of the differential equation, Formation of differential equation, Solution of the differential equation, Solution of the differential equation with variables separable and differential equations reducible to variable separable form, exact differential equation, and equations reducible to exact differential equations, linear and Bernoulli's equations, Euler's equations.

UNIT-IV

(08 hrs)

Multivariable Calculus:

Partial derivatives, Total differential, Chain rule for differentiation, Partial derivatives of higher orders, Homogeneous functions, Euler's theorem on homogeneous functions, differentiation of an implicit function, Jacobian, Maxima and minima of a function of two variables, Lagrange's method of undetermined multipliers.

Suggested Books:

1. G. B. Thomas, R. L. Finney: Calculus and Analytic Geometry, Pearson Education.
2. H. Anton, Irl C Bivens, Stephen Davis: Calculus 10th Edition, John Wiley & Sons.
3. E. Kreyszig: Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. E. Kreyszig and S. Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint 2015.
5. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press.
6. Mathematics Textbook for Class 11th & 12th by NCERT.

Note: The paper setter will set the paper as per the question paper templates provided.

Course Code	ES-109							
Course Title	Engineering Graphics & Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	2	0	3	75	25	100	3h

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

Introduction to Engineering Drawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

Principles of Orthographic Projections- Conventions- Projections of Points and lines inclined to both planes; Projections of planes inclined to one principal Plane.

Projections of Regular Solids:

Solid with axis inclined to both the Planes;

UNIT - III

Sections and Sectional Views of Right Regular Solids:

Sectional views of simple right regular solids like prism, pyramid, Cylinder and Cone. Development of surfaces of Right Regular Solids- Prism, Pyramid, Cylinder and Cone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M. Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E. French, Charles J. Vierck, Robert J. Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Kataria and Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A. Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann, 1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. Corresponding set of CAD Software Theory and User Manuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113L							
Coursetitle	Engineering Graphics & Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3h
Pre-requisites(if any)	-							

Aim:	To make student practice on engineering graphics and designsoftwaresand provide exposurotothevisualaspectsofengineeringdesign.
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1: Overview of Computer Graphics:

Listing the computer technologies that impact on graphical communication, Demonstrating Knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus(Button Bars),The Command Line(where applicable),The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module2: Customization & CAD Drawing:

Setup of the drawing page and the printer ,including scale settings, Setting up of units and drawing limits ;ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Module3: Annotations, layering & other functions:

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

Module4: Demonstration of a simple team design project:

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

Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Corresponding set of)CAD Software Theory and User Manuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Course code	ES-111L							
Coursetitle	Manufacturing Processes Workshop							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	60	40	100	3h
Pre-requisites (if any)								

Aim: To make student gain a hands on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

ManufacturingProcessesWorkshop Contents

1. Manufacturing Methods-casting, forming, machining ,joining, advanced manufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plastic moulding ,glass cutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

BS-141	Biology (Revised)						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time Hrs.
2	1	-	3	75	25	100	3
Purpose	To familiarize the students with the basics of Biology and Biotechnology						
Course Outcomes							
CO1	Introduction to Living world, Cell & Organisms.						
CO2	Introduction to Biomolecules and Biocatalyst						
CO3	Introduction of basic Concept of Genetics & immune system						
CO4	Introduction of basic Concept of Genetic Engineering, Biochemistry & Role of Biology in Different Fields						

Unit – I

Introduction to living world: Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus and endoplasmic reticulum. Difference between prokaryotic and eukaryotic cell. Difference between animal and plant cell.

Classification of Organisms: Classify the organisms on the basis of Cellularity Unicellular and Multicellular organisms. Energy and Carbon Utilization- Autotrophs, Hetrotrophs and Lithotrops. Nitrogen Excretion:- Ammonotelic, Uricotelic and Ureotelic. Habitat- Acquatic & Terrestrial.

Unit-II

Introduction to Biomolecules: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids & Enzymes.

Enzymes as Biocatalysts: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, pH, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action.

Unit-III

Genetics:-Mendel's laws of inheritance. Variation and speciation. Concepts of recessiveness and dominance. Genetic Disorders: Single gene & Multiple genes disorders in human.

Human Traits: Genetics of blood groups, Diabetes Type I & II.

Role of immune system in health and disease: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

Unit-IV

Concepts of Genetic Engineering: Definition; Tools used in recombinant DNA Technology: Enzymes, Vectors & Passenger DNA.

Catabolism: Glycolysis and Krebs cycle, Photosynthesis:- Light and Dark Reaction. Concept of Exothermic and endothermic reactions

Role of Biology: Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Bio-MEMS and Biosensors.

Text Book:

1. Introduction to Biotechnology, By Deswal & Deswal, Dhanpat Rai Publications N.A
2. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.
3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.

D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.

2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.

4. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press Washington DC.

5. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.

6. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.

Note: The paper setter will set the paper as per the question paper templates provided

ES-101	BASIC ELECTRICAL ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time(Hrs)
4	1	-	5	75	25	100	3
Purpose	To familiarize the students with the basics of Electrical Engineering						
Course Outcomes							
CO1	Deals with steady state circuit analysis subject to DC.						
CO 2	Deals with AC fundamentals & steady state circuit response subject to AC.						
CO 3	Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer.						
CO 4	Explains the Basics of Electrical Machines & Electrical installations						

Unit-I

D.C. circuits: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit. Star- Delta transformation for resistors. **Network Theorems:** Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

Unit-II

AC Fundamentals: Mathematical representation of various wave functions. Sinusoidal periodic signal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method. RMS and average values of various waveforms.

A.C. Circuits: Behavior of various components fed by A.C. source (steady state response of pure R, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts. including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

Unit-III

Balanced Three Phase Systems: Generation of alternating 3- phase emf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

Single Phase Transformer (qualitative analysis only): Concept of magnetic circuits. Relation between MMF & Reluctance. Hysteresis & Eddy current phenomenon. Principle, construction & emf equation. Phasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-IV

Electrical Machines (qualitative analysis only): Construction and working of dc machine with commutator action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

Electrical Installations (LT Switchgear): Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

Suggested Books:

1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg. by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals: by Bobrow, Oxford Univ. Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena & Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).

Note: The paper setter will set the paper as per the question paper templates provided.

ES-103L		BASIC ELECTRICAL ENGINEERING LAB					
L	T	Practical	Credit	Minor Test	(Practical)	Total	Time (Hrs)
-	-	2	1	20	30	50	3
Purpose	To familiarize the students with the Electrical Technology Practicals						
Course Outcomes							
CO1	Understand basic concepts of Network theorems						
CO 2	Deals with steady state frequency response of RLC circuit parameters solution techniques						
CO 3	Deals with introductory Single Phase Transformer practicals						
CO 4	Explains the constructional features and practicals of various types of Electrical Machines						

LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency &
Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency &
Q - Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

Note: At least 9 out of the listed experiments to be performed during the semester.