UNIVERSITY SCHOOL OF BIOTECHNOLOGY

Guru Gobind Singh Indraprastha University
Sector 16-C, Dwarka, New Delhi- 110078

Minutes of Board of Studies (USBT)

Meeting of Board of Studies (BOS) members was held on 3rd November 2021 from 10.30 am online using Cisco webex platform. Following members attended the meeting:

1. Prof. Meenu Kapoor, Dean, USBT - Chairperson
2. Prof. P.C. Sharma, Member
3. Prof. K.K. Aggarwal, Member
4. Prof. Promila Gupta, Member
5. Prof. Nimisha Sharma, Member
6. Dr. Ranjith Kumar CT, Member
7. Dr. Gaurav Pandey, Member
8. Dr. Rinu Sharma, Member
9. Prof. Daman Saluja, External Member
10. Prof. Yasha Hasija, External Member
11. Dr. Arindam Bhattacharyya, External Member
12. Prof. G. Abraham, External Member
13. Prof. Asif Mohammad, External Member
14. Sh. Sayan Chatterjee, Special Invitee

Prof. N. Raghuram and Dr. R. S. Purty could not attend the meeting.

The agenda items circulated to the BOS members ahead of the meeting were discussed and deliberated. Following decisions were taken:

Agenda item 1: To finalize 1st year scheme and syllabus of B.Tech. (Biotechnology)

All members actively participated in the deliberations over the agenda item. Some of the observations, comments and suggestions from members were as follows:

a. All members were of the opinion that since the New Education Policy envisages interdisciplinary education without distinction between science, arts and commerce disciplines so integration of engineering and science subjects is important. This will widen the horizon of Biotechnology and engineering students in strengthening their skills and will prepare them for global competitiveness.

b. There is over emphasis on engineering subjects in theory and practical courses.

c. The number of credits being offered in the first and second semester can be reduced.

d. Tutorials can be included to compensate for the numbers of theory subjects in both first and second semesters.

d. Adequate emphasis should be given to intellectual property management, skill development and development of entrepreneurship courses etc.

However, all members noted that since the first year scheme for B.Tech. which is common between the three engineering schools of the university (Biotechnology, USBT; Chemical Technology, USCT and Information Communication and Technology, USICT) has been deliberated for almost a year now and there is consensus in the Academic Council of the university that the first year syllabus for USBT, USCT and USICT should be common, so the first year scheme and syllabus as proposed was approved. It was nevertheless agreed by all members that implementation of this common scheme and syllabus should be reviewed in the school after a year or two of its implementation.

All members also agreed that the scheme and detailed syllabus for 3rd to 8th semester for B.Tech. (Biotechnology) program including the criteria for the award of the degree shall be finalized by the Academic Program Committee of USBT at the earliest so that statutory approvals including approval from USBT Board of Studies can be sought.

Agenda item 2: To approve extension of PhD duration of Ms. Bandita Mohapatra
Prof. Nimisha Sharma, supervisor of Ms. Bandita Mohapatra informed the board members that due to closure of research labs during COVID-19 pandemic one of the Ph.D. objectives of Ms. Bandita could not be completed after 4 years +1 year time period of her Ph.D. program. In view of the above situation, all members approved extension of Ph.D. duration of Ms. Bandita Mohapatra.

Prof. P.C. Sharma, Member	Prof. K.K. Aggarwal, Member	Prof. Promila Gupta, Member	Prof. Nimisha Sharma, Member
Dr. Ranjith Kumar CT, Member	Dr. Gaurav Pandey, Member	Dr. Rinu Sharma, Member	Prof. G. Abraham, External Member
Prof. Daman Saluja, External Member	Prof. Yasha Hasija, External Member	Dr. Arindam Bhattacharyya, External Member	Prof. Asif Mohammad, External Member
Sh. Sayan Chatterjee, Special Invitee	Prof. Meenu Kapoor, Dean, USBT - Chairperson		

Approval of agenda items by all BOS members for BOS meeting held on 03112021

From: **Dr Yasha Hasija** yashahasija@gmail.com
Subject: Re: Request for feedback
Date: 27 November 2021 at 10:43 PM
To: University School of Bio-Technology, GGS IP University,Delhi dean.usbt@ipu.ac.in

YH

Dear Ma'am,

Approved, please.

Thanks and Regards

Yasha

--
Prof. Yasha Hasija
Department of Biotechnology
Delhi Technological University
Delhi-110042

From: **Sayan Chatterjee** sayan@ipu.ac.in
Subject: Re: Minutes BOS meeting
Date: 15 November 2021 at 4:29 PM
To: University School of Bio-Technology, GGS IP University,Delhi dean.usbt@ipu.ac.in

Dear members,
All agenda approved from my side.
Best regards
Sayan

From: **Dr. Rinu Sharma** rinu.sharma@ipu.ac.in
Subject: Re: Revised Minutes BOS meeting
Date: 17 November 2021 at 1:24 PM
To: University School of Bio-Technology, GGS IP University,Delhi dean.usbt@ipu.ac.in

RS

Dear Dr. Meenu
The draft of BoS minutes is fine with me.
Thanks and Best Regards
Dr. Rinu Sharma
Assistant Professor
University School of Biotechnology
Guru Gobind Singh Indraprastha University
Sector 16-C, Dwarka
New Delhi-110078

From: **Daman C Saluja** dsalujach1959@gmail.com
Subject: Re: BOS meeting minutes draft
Date: 13 November 2021 at 12:27 PM
To: Dr. Meenu Kapoor meenukapoor@ipu.ac.in

DS

Looks all good to me except that we thought that scheme shall be ready before start of session instead of 2nd yr as mentioned below.

All members also agreed that the scheme and detailed syllabus for 3
rd to 8
th semester for BTech
(Biotechnology) program including the criteria for the award of the degree shall be finalized by the Academic Program Committee of USBT at the earliest and statutory approvals including approval from USBT Board of Studies shall be taken before the commencement of the 2
nd year of studies for
the batch admitted in the BTech (Biotechnology) program 2021-22.

Rest is good

Best wishes
Daman Saluja

From: **gerard nil abraham** gabraham1@rediffmail.com
Subject: Re: Revised Minutes BOS meeting
Date: 17 November 2021 at 9:40 AM
To: University School of Bio-Technology, GGS IP University,Delhi dean.usbt@ipu.ac.in

GA

This is regarding the revised minutes of the BOS meeting. The minutes are approved in the present form.

From: **Dr. K. K. Aggarwal** kkaggarwal@ipu.ac.in
Subject: Re: 3-8 Sem Scheme APC approved
Date: 27 November 2021 at 9:30 AM
To: University School of Bio-Technology, GGS IP University,Delhi dean.usbt@ipu.ac.in

KA

Approved.

Thanks

Professor K.K.Aggarwal
University School of Biotechnology
GGS Indraprastha University
Sector 16 C, Dwarka,New Delhi-110078

From: **Prakash Sharma** prof.pcsharma@gmail.com
Subject: Re: 3-8 Sem Scheme
Date: 27 November 2021 at 1:07 PM
To: Dr. Meenu Kapoor meenukapoor@ipu.ac.in

PS

Approved from my side.

Professor P. C. Sharma
FNASc., FNAAS
Director Academic Affairs
Professor, University School of Biotechnology
Guru Gobind Singh Indraprastha University
Sector 16C, Dwarka, New Delhi - 110078, INDIA

Tel. +91-11-25302302;06; 25302132
Mobile: +91-9899088818

From: **Asif Mohmmed** amohd@icgeb.res.in
Subject: Re: BOS meeting minutes draft
Date: 15 November 2021 at 12:22 PM
To: University School of Bio-Technology, GGS IP University,Delhi dean.usbt@ipu.ac.in

AM

Dear Dr Kapoor,

The draft of the minutes is fine from my side.

Best wishes
Asif

Asif Mohmmed **Ph.D.**
Group Leader and Principal Investigator
Parasite Cell Biology Group
International Centre for Genetic Engineering and Biotechnology,
Aruna Asaf Ali Marg, New Delhi –110 067
INDIA
Tel: +91-11-26741358
Fax: +91-11-26742316
Email: amohd@icgeb.res.in
amohd21@gmail.com
Webpage: https://www.icgeb.org/mohammed-asif-lab/

From: **Nimisha Sharma** nimisha@ipu.ac.in
Subject: Re: Revised Minutes BOS meeting
Date: 17 November 2021 at 4:03 PM
To: University School of Bio-Technology, GGS IP University,Delhi dean.usbt@ipu.ac.in

NS

Dear Prof. Kapoor,
The minutes are approved from my side.
Thanks,
Nimisha

From: **Dr Gaurav Pandey** gpandey@ipu.ac.in
Subject: Re: Revised Minutes BOS meeting
Date: 18 November 2021 at 3:11 AM
To: University School of Bio-Technology, GGS IP University,Delhi dean.usbt@ipu.ac.in

GP

Dear Prof Meenu,
I was quite busy submitting the report for the ongoing multi-institutional project so couldn't comment promptly.

For Item 1:
I understand the time constraints and urgency we are facing in the implementation of NEP in the coming semester. Nothing can be made perfect on zero-day so I am confident that the scheme & syllabus under NEP will evolve. As discussed and acknowledged there are concerns right now in the first-year scheme related to a large number of credits offered and some engineering courses. This needs to be looked at. Nevertheless, given the time constraint, we should move ahead but prepare ourselves for revision in a year or two. I agree and approve item 1 of minutes.
For Item 2:
I approve the extension of Ph. D, duration for student Ms Bandita
Best Regards
Gaurav

From: **Arindam** a.bhattacharyya@nic.in
Subject: Re: Minutes BOS meeting
Date: 15 November 2021 at 8:07 PM
To: dean usbt dean.usbt@ipu.ac.in

Dear Prof. Meenu Kapoor,

The Minutes are well drafted and comprehensively covers all the points, as discussed in the BOS Meeting held on 3rd November 2021.

I approve the same, as such.

With best regards

Arindam Bhattacharyya

From: **Ranjith Kumar** ctrkumar@ipu.ac.in
Subject: Re: Revised Minutes BOS meeting
Date: 18 November 2021 at 7:54 AM
To: University School of Bio-Technology, GGS IP University,Delhi dean.usbt@ipu.ac.in

Dear Meenu,
I approve the minutes.

Thanks
Ranjith

SCHEME AND SYLLABUS OF EXAMINATION

For

B. Tech. in Biotechnology

2021 onwards

UNIVERSITYSCHOOLOF BIOTECHNOLOGY
GGSINDRAPRASTHAUNIVERSITY
Sector16-C,Dwarka,NewDelhi-110078

Approved in the Board of Studies of USBT held on 3rd November, 2021.

Vision of the School

To Foster Excellence in Biotechnology Education, Research and Industry for Sustainable Development Through Global Thought and Local Action

Mission of the School

To Generate Globally Competitive Manpower and Knowledge-base for Biotechnology, Industry, Education, Research and Development Based on National Values, Social Awareness and Conscience

Programme Outcomes

1. ***Engineering Knowledge*** (**PO01**): Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. ***Problem Analysis*** (**PO02**): Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. ***Design/Development of Solutions*** (**PO03**): Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
4. ***Conduct Investigations of Complex Problems*** (**PO04**): Use research – based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems:
    a. That cannot be solved by straight forward application of knowledge, theories and techniques applicable to the engineering discipline as against problems given at the end of chapters in a typical text book that can be solved using simple engineering theories and techniques;
    b. that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions;
    c. that require consideration of appropriate constraints / requirements not explicitly given in the problem statement such as cost, power requirement, durability, product life, etc.;
    d. which need to be defined (modelled) with inappropriate mathematical framework; and
    e. that often require use of modern computational concepts and tools, for example, in the design of an antenna or a DSP filter.
5. ***Modern Tool Usage*** (**PO05**): Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. ***The Engineer and Society*** (**PO06**): Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. ***Environment and Sustainability*** (**PO07**): Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. ***Ethics*** (**PO08**): Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. ***Individual and Team Work*** (**PO09**): Function effectively as an individual, and as a member or leader in diverse teams, and in multi disciplinary settings.
10. ***Communication*** (**PO10**): Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. ***Project Management and Finance*** (**PO11**): Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's

own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.

12. ***Life-long Learning*** (**PO12**): Recognize the need for, and have the preparation and ability to engage in independent and life long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

PSO01: Acquire knowledge about fundamentals of biotechnology for sound and solid base to understand the emerging and advanced engineering concepts in life sciences.

PSO02: Acquire knowledge in domain of biotechnology enabling their applications in industry and research.

PSO03: Empowering students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology.

PSO04: Recognize the importance of Bioethics, IPR, entrepreneurship, communication and management skills so as to usher next generation of global industrialists.

Programme Educational Objectives (PEOs)

PEO 01: Understand and apply concepts of biotechnology, chemical engineering, computational techniques, instrumentation and related aspects of science and technology for pursuing higher studies and building successful careers in industry.

PEO 02: Apply acquired practical skills and broad biotechnological trainings in product, process and technique development to meet societal demands at large.

PEO 03: Participate in individual and team oriented, open ended activities aiding constructive thinking to provide opportunity for students to manage and work on multidisciplinary projects.

PEO 04: Demonstrate professional and ethical attitude with awareness of current issues and think about the social entailment of their work, especially its impact on safety, health and environment for sustainable development.

PEO 05: To promote student awareness for life-long learning and to introduce them to professional ethics and codes of professional practice.

SCHEME OF EXAMINATION

FIRST YEAR

For

Biotechnology Major Discipline

First Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
	Theory Papers				
ES	ICT101	Programming for Problem Solving	3	-	3
ES	ICT103	Electrical Science	3	-	3
ES	ICT105	Engineering Mechanics	3	-	3
HS	HS107	Communication Skills-I	3	-	3
BS	BS109	Engineering Chemistry – I	3	-	3
BS	BS111	Engineering Mathematics – I	4	-	4
BS	BS113	Engineering Physics – I	3	-	3
HS/MC	LLB115*	Indian Constitution	2	-	2
	Practical/Viva Voce				
ES	ICT151	Programming for Problem Solving Lab.	-	2	1
ES	ICT153	Engineering Graphics-I	-	2	1
ES	ICT155	Electrical Science Lab.	-	2	1
BS	BS157	Engineering Chemistry-I Lab	-	2	1
BS	BS159	Engineering Physics - I Lab	-	2	1
Total			**24**	**10**	**29**

***NUES : Comprehensive evaluation by the teacher concerned out of 100.**

Second Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
	Theory Papers				
ES		School Specific Engineering Science Paper**			3
HS	HS102	Communication Skills – II	3	-	3
BS	BS104	Engineering Chemistry – II	3	-	3
BS	BS106	Engineering Mathematics - II	4	-	4
BS	BS108	Engineering Physics-II	3	-	3
BS	BS110	Probability and Statistics for Engineers ***	3	2	4
HS/MC	ICT114*	Human Values and Ethics	1	-	1
BS/MC	EMES112	Environmental Studies	4	-	4
	Practical/Viva Voce				
ES	ICT152	Engineering Graphics-II Lab.	-	2	1
BS	BS156	Engineering Chemistry – II Lab	-	2	1
BS	BS158	Engineering Physics –II Lab	-	2	1
One paper from the following#:					
ES	ICT154	Workshop Technology		2	1
ES	ICT160	Programming in Python		2	
Total			**24**	**8**	**29**

*NUES: Comprehensive evaluation by the teacher out of 100, no term end examination shall be held.

Either Workshop practice or Programming in Python paper shall be offered to the students by the school. If Workshop Technology paper is offered it shall be considered as a Theory paper otherwise Workshop practice shall be considered as practical paper

**School Specific Engineering Science Paper in this semester for students of University School of Biotechnology (USBT) shall be BT-120 (Introduction to Biotechnology) as approved by the Board of Studies of USBT and decided by the Academic Programme Committee of the School. This shall be offered in the first year/second semester.

Second Semester Open Elective from the School					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
	Open Elective Papers				
ES	ICT116	Introduction to Manufacturing Process	3	-	3
ES	BS118	Industrial Chemistry	3	-	3
ES	BT120	Introduction to Biotechnology	3	-	3

*** The Teachers' Continuous Evaluation Component shall be 25, Term end theory examinations of 50 marks and term end practical marks shall be of 25 marks maximum. The marks obtained in each component by the student shall be reflected in the marksheet.

SYLLABUS

FIRSTYEAR

For

Biotechnology Major Discipline

Paper Code: ICT101	Paper: Programming for Problem Solving	L	T/P	C
PaperID: 164101		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart basic knowledge about simple algorithms for arithmetic and logical problems so that students can understand how to write a program, syntax and logical errors in 'C'.
2:	To impart knowledge about how to implement conditional branching, iteration and recursion in 'C'.
3:	To impart knowledge about using arrays, pointers, files, union and structures to develop algorithms and programs in 'C'.
4:	To impart knowledge about how to approach for dividing a problem into sub-problems and solve the problem in 'C'.

Course Outcomes (CO):

CO1:	Ability to develop simple algorithms for arithmetic and logical problems and implement them in 'C'.
CO2:	Ability to implement conditional branching, iteration and recursion and functions in 'C'
CO3:	Ability to use arrays, pointers, union and structures to develop algorithms and programs in 'C'.
CO4:	Ability to decompose a problem into functions and synthesize a complete program using divide and conquer approach in 'C'.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Introduction to Programming: Computer system, components of a computer system, computing environments, computer languages, creating and running programs, Preprocessor, Compilation process, role of linker, idea of invocation and execution of a programme.
Algorithms: Representation using flowcharts, pseudocode.
Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types, I/O statements. Interconversion of variables.
Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions. [10Hrs]

Unit II

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.
Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays.
Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion.
Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions. [10Hrs]

Unit III

Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, functions returning pointers, Dynamic memory allocation. Pointers to functions. Pointers and Strings
Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, self referential structures, unions, typedef, enumerations.
File handling: command line arguments, File modes, basic file operations read, write and append.
Scope and life of variables, multi-file programming.
C99 extensions. 'C' Standard Libraries: stdio.h, stdlib.h, assert.h, math.h, time.h, ctype.h, setjmp.h, string.h, stdarg.h, unistd.h
[10Hrs]

Unit IV

Basic Algorithms: Finding Factorial, Fibonacci series, Searching, Basic Sorting Algorithms- Bubble sort, Insertion sort and Selection sort. Find the square root of a number, array order reversal, reversal of a string, two-way merge sort, stacks, queues, single –link l inked list, Binary search tree. [10Hrs]

Textbooks:

1. *How to solve it by Computer* by R. G. Dromey, Prentice-Hall India EEE Series, 1982.
2. *The C programming language* by B W Kernighan and D M Ritchie, Pearson Education, 1988.

References:

1. *Programming Logic & Design* by Tony Gaddis, Pearson, 2nd Ed. 2016.
2. *Programming Logic and Design* by Joyce Farrell, Cengage Learning, 2015.
3. *Engineering Problem Solving With C* by Delores M. Etter, Pearson, 2013.
4. *Problem Solving and Program Design in C* by Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016.
5. *Structure and Interpretation of Computer Programs* by Harold Abelson and Gerald Sussman with Julie Sussman, MIT Press, 1985.
6. *How to Design Programs* by Matthias Felleisen, Robert Bruce Findler, Matthew Flatt, and Shriram Krishnamurthi, MIT Press, 2018.
7. *ANSI/ISO 9899-1990, American National Standard for Programming Languages 'C'* by American National Standards Institute, Information Technology Industry Council, 1990 (C89).
8. *ISO/IEC 9899:1999. International Standard for Programming Languages – C (ISO/IEC 9899)* by American National Standards Institute, Information Technology Industry Council, 2000 (C99).
9. *INCITS/ISO/IEC 9899-2011.American National Standard for Programming Languages 'C'* by American National Standards Institute, Information Technology Industry Council, 2012 (C11).

PaperCode: ICT103	Paper: Electrical Science	L	T/P	C
PaperID: 164103		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge of the basics electrical engineering.
2:	To impart knowledge of the working of RLC circuits.
3:	To impart basic knowledge about filters and magnetic circuits.
4:	To impart basic knowledge about electrical machines.

Course Outcomes (CO):

CO1:	Ability to understand and use Kirchpff's Laws to solve resistive circuit problems.
CO2:	Ability to analyse resistive, inductive and capacitive circuits for transient and steady state sinusoidal solutions.
CO3:	Understand the first order filters and magnetic circuits.
CO4:	Understand the design of electrical machines.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	3	-	-	-	1	1	1	2
CO2	3	3	3	3	3	-	-	-	1	1	1	2
CO3	3	3	3	3	3	-	-	-	1	1	1	2
CO4	3	3	3	3	3	-	-	-	1	1	1	2

Unit - I

DC Circuits: Passive circuit components, Basic laws of Electrical Engineering, Temperature Resistance Coefficients. voltage and current sources, Series and parallel circuits, power and energy, Kirchhoff's Laws, Nodal & Mesh Analysis, delta-star transformation, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem. Time domain analysis of first Order RC & LC circuits.[10Hrs]

Unit – II

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections. [10Hrs]

Unit - III

D. C. Generators & Motors: Principle of operation of Generators & Motors, Speed Control of shunt motors, Flux control, Rheostatic control, voltage control, Speed control of series motors.

A. C. Generators & Motors: Principle of operation, Revolving Magnetic field, Squirrel cage and phase wound rotor, Starting of Induction motors, Direct on line and Star Delta starters, Synchronous machines. [10Hrs]

Unit - IV:

Transformers: Construction and principle of operation, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Measuring Instruments: Electromagnetism, Different Torques in Indicating instruments, Moving Iron Instruments: Construction & Principle, Attraction and Repulsion type; Moving Coil instruments: Permanent Magnet type; Dynamometer type Instruments.

[10Hrs]

Textbooks:

1. *Electrical Engineering Fundamentals* by Vincent Del Toro, PHI (India), 1989

References:

1. *An Introduction to Electrical Science* by Adrian Waygood, Routledge, 2nd Ed. 2019.
2. *Electrical Circuit Theory and Technology* by John Bird, Elsevier, 2007.
3. *Principles and Applications of Electrical Engineering* by Giorgio Rizzoni, MacGraw-Hill, 2007.
4. *Electrical Engineering* by Allan R. Hambley, Prentice-Hall, 2011.
5. *Hughes Electical & Electronic Technology* by Edward Hughes revised by Hohn Wiley, Keith Brown and Ian McKenzie Smith, Pearson, 2016.
6. *Electrical and Electronics Technology* by E. Hughes, Pearson, 2010.
7. Basic Electrical Engineering by D.C. Kulshrestha, McGraw-Hill, 2009.
8. Basic Electrical Engineering by D. P. Kothai and I.J. Nagrath, McGraw-Hill, 2010.

PaperCode: ICT105	Paper: Engineering Mechanics	L		T/P	C
PaperID: 164105		3		-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge to solve problems pertaining to force systems, equilibrium and distributed systems.
2:	To impart knowledge to solve problems of friction and engineering trusses.
3:	To impart knowledge to deal with the problems of kinematics and kinetics of particle
4:	To impart knowledge to deal with the problems of kinematics and kinetics of rigid bodies.

Course Outcomes (CO):

CO1:	Ability to solve problems pertaining to force systems, equilibrium and distributed systems.
CO2:	Ability to solve problems of friction and engineering trusses.
CO3:	Ability to deal with the problems of kinematics and kinetics of particle
CO4:	Ability to deal with the problems of kinematics and kinetics of rigid bodies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*		*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	1		1	2
CO2	3	3	3	3	2	-	-	-	1	1		1	2
CO3	3	3	3	3	2	-	-	-	1	1		1	2
CO4	3	3	3	3	2	-	-	-	1	1		1	2

Unit I

Force System: Introduction, force, principle of transmissibility of force, resultant of a force system, resolution of a force, moment of force about a line, Varigon's theorem, couple, resolution of force into force and a couple, properties of couple and their application to engineering problems.

Equilibrium: Force body diagram, equations of equilibrium and their applications to engineering problems, equilibrium of two force and three force members.

Distributed Forces: Determination of center of gravity, center of mass and centroid by direct integration and by the method of composite bodies, mass moment of inertia and area moment of inertia by direct integration and composite bodies method, radius of gyration, parallel axis theorem, polar moment of inertial.[10Hrs]

Unit II

Structure: Plane truss, perfect and imperfect truss, assumption in the truss analysis, analysis of perfect plane trusses by the method of joints, method of section and graphical method.

Friction: Static and Kinetic friction, laws of dry friction, co-efficient of friction, angle of friction, angle of repose, cone of friction, frictional lock, friction in flat pivot and collar bearing, friction in flat belts. [10Hrs]

Unit III

Kinematics of Particles: Rectilinear motion, plane curvilinear motion, rectangular coordinates, normal and tangential coordinates.

Kinetics of Particles: Equation of motion, rectilinear motion and curvilinear motion, work-energy equation, conservation of energy, concept of impulse and momentum, conservation of momentum, impact of bodies, co-efficient of restitution, loss of energy during impact. [10Hrs]

Unit IV

Kinematics of Rigid Bodies: Concept of rigid body, types of rigid body motion, absolute motion, introduction to relative velocity, relative acceleration (Corioli's component excluded) and instantaneous center of zero velocity, Velocity and acceleration.

Kinetics of Rigid Bodies: Equation of motion, translatory motion and fixed axis rotation, application of work energy principles to rigid bodies conservation of energy.

Beam: Introduction, types of loading, methods for the reactions of a beam, space diagram, types of end supports, beams subjected to couple. [10Hrs]

Textbooks:

1.*Engineering Mechanics* by A.K.Tayal, Umesh Publications.

References:

1. 'Engineering Mechanics' by K. L. Kumar, Tata Mc-Graw Hill

2. *'Engineering Mechanics' by S. Timoshenko, D. H. Young, J. V. Rao, Tata Mc-Graw Hill*
3. *'Engineering Mechanics-Statics and Dynamics' by Irwing H. Shames, PHI.*
4. *'Engineering Mechanics' by Basudev Bhattacharya, Oxford Higher Education.*

PaperCode: HS107	Paper: Communication Skills - I	L	T/P	C
PaperID: 99107		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.

Course Objectives:

1:	To help them understand the structures of language, and build up the vocabulary.
2:	To enhance language proficiency and communication competence.
3:	To understand basic principles of written communication.
4:	To develop the efficiency of using language for Specific Purposes with clarity.
5:	To be able to critically appreciate the written texts and audio-visual inputs effectively.
6:	To develop the theoretical understanding of interpersonal communication effectively.

Course Outcomes (CO):

CO1:	Ability to understand the basic structure of language
CO2:	Ability to communicate effectively in writing.
CO3:	Ability to present their ideas effectively in professional and demanding situations.
CO4:	Ability to interpret texts and comprehend the extended discourse.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	-	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	3
CO4	-	-	-	-	-	-	-	-	3	3	-	3

Unit I

Basic Language Efficiency 1: Parts of Speech, Sentence Structure, Subject-Verb Agreement, Vocabulary, Common Errors,

[8Hrs]

Unit II

Basic Language Efficiency 2: Writing Skills: Types of Writing, Paragraph writing,Paraphrasing, Summarizing, Précis Writing

[8Hrs]

Unit III

Formal Written Communication: Meetings – Agenda and Minutes,Press release, Letter writing, Notice, Memorandum, E-mails

[8Hrs]

Unit IV

Appreciating written Texts for comprehension ability:

1. Steven Spielberg's Speech at Harvard Commencement 2016(https://www.youtube.com/watch?v=TYtoDunfu00)
2. Lecture by Johan Rockstrom: Let the Environment Guide our Development http://www.ted.com/talks/johan_rockstrom_let_the_environment_guide_our_development

[8Hrs]

Textbooks:

1. *High English Grammar and Composition* by Wren, P.C. & Martin H., S.Chand & Company Ltd, New Delhi.
2. *Technical Communication: Principles & Practice* by Meenakshi Raman, New Delhi: Oxford University Press

References:

1. *Be Grammar Ready: The Ultimate Guide to English Grammar* by John Eastwood, New Delhi, Oxford University Press, 2020.
2. *Communication Skills: A Workbook* by Sanjay Kumar & Pushp Lata, New Delhi, Oxford University Press, 2018.
3. *Basic Technical Communication* by Kavita Tyagi & Padma Mishra, New Delhi, PHI Learning, 2012.
4. *Advanced Technical Communication* by Kavita Tyagi & Padma Mishra, New Delhi, PHI Learning, 2011.

PaperCode: BS109	Paper: Engineering Chemistry - I	L	T/P	C
PaperID: 99109		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge about understanding and modeling atomic structure and chemical bonding.
2:	To impart knowledge about understanding and modeling Thermochemistry and Reaction Kinetics.
3:	To impart knowledge about understanding and modeling organic compound structure and reactions.
4:	To impart knowledge about understanding and modeling Stereochemistry.

Course Outcomes (CO):

CO1:	Ability to understand and model atomic structure and chemical bonding.
CO2:	Ability to understand and model Thermochemistry and Reaction Kinetics.
CO3:	Ability to understand and model organic compound structure and reactions.
CO4:	Ability to understand and model Stereochemistry.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Atomic Structure: Introduction to wave mechanics, the Schrödinger equation as applied to hydrogen atom, origin of quantum numbers, Long form of periodic table on the basis of Electronic configuration s, p, d, f block elements periodic trends, Ionization potential, atomic and ionic radii electron affinity & electro-negativity.

Chemical Bonding: Ionic bond, energy changes, lattice energy Born Haber Cycle, Covalent bond-energy changes, Potential energy curve for H2 molecule, characteristics of covalent compound, co-ordinate bond-Werner's Theory, effective atomic numbers, A hybridization and resonance, Valence Shell Electron Repulsion theory (VSEPR), Discussion of structures of H2O, NH3, BrF3, SiF4, Molecular orbital theory, Linear combination of atomic orbitals (LCAO) method. Structure of simple homo nuclear diatomic molecule like H2, N2, O2, F2.

[12Hrs]

Unit II

Thermochemistry: Hess's Law, heat of reaction, effect of temperature on heat of reaction at constant pressure (Kirchhoff's Equation) heat to dilution, heat of hydration, heat of neutralization and heat of combustion, Flame temperature. Reaction Kinetics: Significance of rate law and rate equations, order and molecularity, Determinations of order of simple reactions-experimental method, Equilibrium constant and reaction rates -Lindermann, collision and activated complex theories, complex reactions of 1st order characteristics of consecutive, reversible and parallel reactions-Steady state and non-steady state approach.

[10 Hrs]

Unit III

Basic concepts of Organics: Inductive, electromeric, mesomeric and hyperconjugative effects. Stability of reaction intermediates. Electrophiles and nucleophiles, concepts of acids and bases. Arrhenius, Lowry-Bronsted and Lewis theory of acids and bases (HSAB), Carbon acids (active methylene groups), super acids. Bonds weaker than covalent bond: Hydrogen bonding - nature, types, stability and effects. IUPAC Nomenclature. [8Hrs]

Unit IV

Stereochemistry: Classification of stereoisomers, diastereomers, Separation of enantiomers. Absolute configuration (R and S), Projection formulae. Stereochemistry of compounds containing two asymmetric C-atoms. Elements of symmetry - center, plane and axis of symmetry, Conformations: Conformations around a C-C bond in acyclic and cyclic compounds.

[10Hrs]

Textbooks / References:

1. Engineering Chemistry (16th Edition) Jain, Jain, Dhanpat Rai Publishing Company, 2013.
2.Textbook of Engineering Chemistry by Jaya Shree Anireddy, Wiley, 2017
3.Engineering Chemistry by E.R. Nagarajan and S. Ramalingam, Wiley, 2017.

PaperCode: BS111	Paper: Engineering Mathematics – I	L	T/P	C
PaperID: 99111		4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand use series, differential and integral methods to solve formulated engineering problems.
2:	To understand use Ordinary Differential Equations to solve formulated engineering problems.
3:	To understand use linear algebrato solve formulated engineering problems.
4:	To understand use vector calculusto solve formulated engineering problems.

Course Outcomes (CO):

CO1:	Ability to use series, differential and integral methods to solve formulated engineering problems.
CO2:	Ability to use Ordinary Differential Equations to solve formulated engineering problems.
CO3:	Ability to use linear algebrato solve formulated engineering problems.
CO4:	Ability to use vector calculusto solve formulated engineering problems.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	3	3	3	1	-	-	-	-	-	1	2
CO2	2	3	3	3	1	-	-	-	-	-	2	2
CO3	2	3	3	3	1	-	-	-	-	-	2	2
CO4	2	3	3	3	1	-	-	-	-	-	2	2

Unit I

Partial derivatives, Chain rule, Differentiation of Implicit functions, Exact differentials. Maxima, Minima and saddle points, Method of Lagrange multipliers. Differentiation under Integral sign, Jacobians and transformations of coordinates.

[8Hrs]

Unit II

Ordinary Differential Equations (ODEs): Basic Concepts. Geometric Meaning of y'= f(x, y). Direction Fields, Euler's Method, Separable ODEs. Exact ODEs. Integrating Factors, Linear ODEs. Bernoulli Equation. Population Dynamics, Orthogonal Trajectories. Homogeneous Linear ODEs with Constant Coefficients. Differential Operators. Modeling of Free Oscillations of a Mass–Spring System, Euler–Cauchy Equations. Wronskian, Nonhomogeneous ODEs, Solution by Variation of Parameters.

Power Series Method for solution of ODEs: Legendre's Equation. Legendre Polynomials, Bessel's Equation, Bessels's functions Jn(x) and Yn(x). Gamma Function [12Hrs]

Unit III

Linear Algebra: Matrices and Determinants, Gauss Elimination, Linear Independence. Rank of a Matrix. Vector Space. Solutions of Linear Systems and concept of Existence, Uniqueness, Determinants. Cramer's Rule, Gauss–Jordan Elimination. The Matrix Eigenvalue Problem.

Determining Eigenvalues and Eigenvectors, Symmetric, Skew-Symmetric, and Orthogonal Matrices.Eigenbases. Diagonalization. Quadratic Forms.Cayley – Hamilton Theorem (without proof) [10Hrs]

Unit IV

Vector Calculus: Vector and Scalar Functions and Their Fields. Derivatives, Curves. Arc Length. Curvature. Torsion, Gradient of a Scalar Field. Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field, Line Integrals, Path Independence of Line Integrals, Double Integrals, Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Stokes Theorem. Divergence Theorem of Gauss.

[10Hrs]

Textbooks:

1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th Ed., 2011.
2. *Mathematical Methods for Physics and Engineering*, by K. F. Riley, M. P. Hobson and S. J. Bence, CUP, 2013. (for Unit I)

References:

1. *Engineering Mathematics* by K.A. Stroud withDexter J. Booth, Macmillan, 2020.
2. *Advanced Engineering Mathematics* by Larry Turyn, Taylor and Francis, 2014.
3. *Advanced Engineering Mathematics* by Dennis G. Zill, Jones & Bartlett Learning, 2018.
4. *Advanced Engineering Mathematics with MATLAB* by Dean G. Duffy, Taylor and Francis, 2017.

5. *Advanced Engineering Mathematics* by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland), 2019.

PaperCode: BS113	Paper: Engineering Physics – I	L	T/P	C
PaperID: 99113		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand thermodynamic principles.
2:	To understand and model oscillations and waves.
3:	To understand and model interference, diffraction and polarization phenomenon.
4:	To understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO):

CO1:	Ability to apply thermodynamic principles to solution of engineering problems.
CO2:	Ability to understand and model oscillations and waves.
CO3:	Ability to understand and model interference, diffraction and polarization phenomenon.
CO4:	Ability to understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	2
CO2	2	2	3	3	2	-	-	-	1	1	-	2
CO3	2	2	3	3	2	-	-	-	1	1	-	2
CO4	2	2	3	3	2	-	-	-	1	1	-	2

Unit I

Introduction to Thermodynamics: Fundamental Ideas of Thermodynamics, The Continuum Model, The Concept of a "System'", "State", "Equilibrium", "Process'". Equations of state, Heat, Zeroth Law of Thermodynamics, Work, first and second laws of thermodynamics, entropy [8Hrs]

Unit II

Waves and Oscillations: Wave motion, simple harmonic motion, wave equation, superposition principle. Introduction to Electromagnetic Theory: Maxwell's equations. work done by the electromagnetic field, Poynting's theorem, Momentum, Angular momentum in electromagnetic fields, Electromagnetic waves: the wave equation, plane electromagnetic waves, energy carried by electromagnetic waves [8Hrs]

Unit III

Interference: Interference by division of wave front (Young's double slit experiment, Fresnel's biprism), interference by division of amplitude (thin films, Newton's rings, Michelson's interferometer), Coherence and coherent sources

Diffraction: Fraunhofer and Fresnel diffraction; Fraunhofer diffraction for Single slit, double slit, and N-slit (diffraction grating), Fraunhofer diffraction from a circular aperture, resolving power and dispersive power of a grating, Rayleigh criterion, resolving power of optical instruments

Polarization: Introduction to polarization, Brewster's law, Malu's law, Nicol prism, double refraction, quarter-wave and half-wave plates, optical activity, specific rotation, Laurent half shade polarimeter. [12Hrs]

Unit IV

Theory of relativity: The Michelson-Morley Experiment and the speed of light; Absolute and Inertial frames of reference, Galilean transformations, the postulates of the special theory of relativity, Lorentz transformations, time dilation, length contraction, velocity addition, mass energy equivalence. Invariance of Maxwell's equations under Lorentz Transformation.

Introduction to Laser Physics: Introduction, coherence, Einstein A and B coefficients, population inversion, basic principle and operation of a laser, the He-Ne laser and the Ruby laser [12Hrs]

Textbooks:

1. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury,McGraw-Hill, 2017.
2. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017

References:

1. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.
2. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.
3. *Optics* by Ajoy Ghatak, McGraw Hill, 2020.

PaperCode: LLB115	Paper: Indian Constitution	L	T/P	C
PaperID: 99115		2	-	2

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter (Maximum Marks for Term End Examinations: 75):

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives:

1:	To create awareness among students about the Indian Constitution
2:	To create consciousness among students about democratic principles and enshrined in the Constitution of India

Course Outcomes (CO):

CO1:	To understand institutional mechanism and fundamental values enshrined in the Constitution of India
CO2:	To understand the inter-relation between Centre and State Government
CO3:	To understand Fundamental Rights and Duties
CO4:	To understand the structure and functions of judicial systems in the country.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	3	-	2	-	-	-	1
CO2	-	-	-	-	-	3	-	2	-	-	-	1
CO3	-	-	-	-	-	3	-	2	-	-	-	1
CO4	-	-	-	-	-	3	-	2	-	-	-	1

Unit I

Introduction to Constitution of India: Definition, Source and Framing of the Constitution of India.Salient Features of the Indian Constitution. Preamble of the Constitution. [6Hrs]

Unit II

Fundamental Rights and Duties: Rights To Equality (Article 14-18).Rights to Freedom (Article 19-22).Right against Exploitation (Article 23-24).Rights to Religion and Cultural and Educational Rights of Minorities(Article 25- 30). The Directive Principles of State Policy – Its significance and application. Fundamental Duties – Necessary obligations and its nature, legal status and significance [6Hrs]

Unit III

Executives and Judiciary: Office of President, Vice President and Governor: Power and Functions, Parliament, Emergency Provisions-, President Rule; Union Judiciary: Appointment of Judges, Jurisdiction of the Supreme Court, State Judiciary: Power and functions, Writ Jurisdiction [6Hrs]

Unit IV

Centre- States Relation: Is Indian Constitution Federal in Nature, Legislative relations between Union and States, Administrative Relations between Union and States, Financial Relations between Union and States [6Hrs]

Textbooks:

1. *Constitutional Law of India* by J.N Pandey, Central Law Publication, 2018.
2. *Introduction to the Indian Constitution of India*by D.D. Basu, PHI, New Delhi, 2021
3. *The Constitution of India* by P.M. Bakshi, Universal Law Publishing Co., 2020.

References:

1. *Indian Constitutional Law* by M.P. Jain, Lexis Nexis, 2013
2.*Constitution of India* byV.N. Shukla, Eastern Book Agency, 2014

PaperCode: ICT151	Paper: Programming for Problem Solving Lab.		L	P	C
PaperID: 164151			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:

1. The course objectives and course outcomes are identical to that of ICT101 (Programming for Problem Solving) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

PaperCode: ICT153	Paper: Engineering Graphics-I	L	P	C
PaperID: 164153		-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Course Objectives:

1:	The students will learn the introduction of Engineering graphics, various equipment used, various scales, dimensions and BIS codes used while making drawings for various streams of engineering disciplines.
2:	The students will learn theory of projections and projection of points.
3:	The students will learn projection of lines and projection of planes.
4:	The students will learn the projection of solid and development of surfaces

Course Outcomes (CO):

CO1:	To understand the theory of projections and projection of points.
CO2:	Ability to do line projections.
CO3:	Ability to do plane projections.
CO4:	Ability to do solid projections and development of surfaces

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	2	1	2
CO2	3	3	3	3	2	-	-	-	1	2	1	2
CO3	3	3	3	3	2	-	-	-	1	2	1	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

Unit I

Introduction: Engineering Graphics/Technical Drawing, Introduction to drawing equipments and use of instruments, Conventions in drawing practice. Types of lines and their uses, BIS codes for lines, technical lettering as per BIS codes, Introduction to dimensioning, Types, Concepts of scale drawing, Types of scales

Theory of Projections: Theory of projections, Perspective, Orthographic, System of orthographic projection: in reference to quadrants, Projection of Points, Projection in different quadrants, Projection of point on auxiliary planes. Distance between two points, Illustration through simple problems.

Unit II

Projection of Lines: Line Parallel to both H.P. and V.P., Parallel to one and inclined to other, Other typical cases: three view projection of straight lines, true length and angle orientation of straight line: rotation method, Trapezoidal method and auxiliary plane method, traces of line.

Unit III

Projection of Planes: Projection of Planes Parallel to one and perpendicular to other, Perpendicular to one and inclined to other, Inclined to both reference planes, Plane oblique to reference planes, traces of planes.

Planes Other than the Reference Planes: Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., projections of points and lines lying in the planes, conversion of oblique plane into auxiliary plane and solution of related problems.

Unit IV

Projection of Solids: Projection of solids in first or third quadrant, Axis parallel to one and perpendicular to other, Axis parallel to one inclined to other, Axis inclined to both the principal plane, Axis perpendicular to profile plane and parallel to both H.P. and V.P., Visible and invisible details in the projection, Use of rotation and auxiliary plane method.

Development of Surface: Purpose of development, Parallel line, radial line and triangulation method, Development of prism, cylinder, cone and pyramid surface for both right angled and oblique solids, Development of surface.

Note: The sheets to be created shall be notified by the concerned teacher in the first week of teaching.

Textbooks:

1. *Engineering Drawing* by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat,2017.

References:

1. *Engineering Drawing*by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.
2. *Technical Drawing with Engineering Graphics* by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016
3. *Engineering Drawing*by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.

PaperCode: ICT155	Paper: Electrical Science Lab.		L	P	C
PaperID: 164155			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:

1. The course objectives and course outcomes are identical to that of ICT103 (Electrical Science) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement.

PaperCode: BS157	Paper: Engineering Chemistry - I Lab.		L	P	C
PaperID: 99157			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:

1. The course objectives and course outcomes are identical to that of BA109 (Engineering Chemistry - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

PaperCode: BS159	Paper: Engineering Physics - I Lab.		L	P	C
PaperID: 99159			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:

1. The course objectives and course outcomes are identical to that of BA113 (Engineering Physics - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

PaperCode: HS102	Paper: Communication Skills - ll	L	T/P	C
PaperID: 99102		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper.

Course Objectives:

1:	To develop the theoretical framework of communication to understand the professional interaction.
2:	To develop confidence in all aspects of communication whether verbal or non-verbal.
3:	To be able to create error-free and well-formatted formal documents for professional records.
4:	To be able to overcome the barriers to effective communication.
5:	To inculcate the capacity to organize ideas and systematically present them through various media.
6:	To be able to critically appreciate the written texts and audio-visual inputs effectively.

Course Outcomes (CO):

CO1:	Ability to understand basic concepts regarding communication and develop a clear understanding of the flow of thoughts.
CO2:	Ability to apply verbal and non-verbal communication skills in real-life situations.
CO3:	Ability to write and document the information in the appropriate formats.
CO4:	Ability to effectively communicate in interpersonal and intercultural situations without being misunderstood.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	-	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	3
CO4	-	-	-	-	-	-	-	-	3	3	-	3

Unit I

Communication as Process: Concept of Communication, Communication as a Process, Formal, Informal and Intercultural communication, Barriers to Effective Communication and remedies, Characteristics of Effective Communication

[8Hrs]

Unit II

Communication Efficiency: Concept of Non-verbal Communication, Elements of Non-verbal Communication – Gestures, Postures, Facial-expressions, Gaze, Eye contact, and Space, Presentation skills – Interviews, Group Discussion, Making presentations with Audio-visual aids, Electronic Communication – Internet and Social media.

[8Hrs]

Unit III

Technical Documents: Definition, Types, Structure, Significant Features of: Resume Writing, Report Writing, Proposal Writing, Dissertation, and Research Papers [8Hrs]

Unit IV

Communication in Society and Workplace:

Text 1 – Gender-inclusive Language

Background, Purpose, and Guidelines

United Nations Gender-inclusive Language

https://www.un.org/en/gender-inclusive-language/index.shtml

Text 2 – Cultural Diversity in India

India: Unity in Cultural Diversity Introduction (P. xii – xviii)

https://dsel.education.gov.in/sites/default/files/book_unity_in_diversity.pdf

Text 3 – The Matrix (1999)

Genre: Movie (Science Fiction)

Dir. The Wachowski Brothers

[8Hrs]

Textbooks:

1. *High English Grammar and Composition* by Wren, P.C. & Martin H., S. Chand & Company Ltd, New Delhi.
2. *Technical Communication: Principles & Practice* by Meenakshi Raman, New Delhi: Oxford University Press

References:

1. *Be Grammar Ready: The Ultimate Guide to English Grammar* by John Eastwood, New Delhi, Oxford University Press, 2020.

2. *Communication Skills: A Workbook* by Sanjay Kumar & Pushp Lata, New Delhi, Oxford University Press, 2018.
3. *Basic Technical Communication* by Kavita Tyagi & Padma Mishra, New Delhi, PHI Learning, 2012.
4. *Advanced Technical Communication* by Kavita Tyagi & Padma Mishra, New Delhi, PHI Learning, 2011.

PaperCode: BS104	Paper: Engineering Chemistry - ll	L	T/P	C
PaperID: 99104		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand methods to make pure water and use fuels.
2:	To understand the use of techniques used to characterize engineering materials.
3:	To understand the properties and industrial applications of polymers.
4:	To understand the basics of nano-technology and bio chemistry

Course Outcomes (CO):

CO1:	Ability to make pure water and use fuels and perform energy conversion calculations
CO2:	Ability to use techniques used to characterize engineering materials.
CO3:	Understand the properties and industrial applications of polymers.
CO4:	Understand the basics of nano-technology and bio chemistry

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Water treatment: Introduction, Hardness of water, Disadvantages of hard water, Water-softening-Lime-Soda process, Ion-exchanger polished water, Boiled-feed water, boiler problems-scale, sludge priming and foaming, caustic embrittlement and corrosion.

Fuels: Classification of fuels, Calorific values, Comparison between solid, liquid and gaseous fuels, Bomb calorimeter, Calorific value of gaseous fuel, Theoretical calculation of calorific value of a fuel, Wood, Coal, Analysis of coal, Natural Gas, Producer gas, water gas, Non-Conventional sources of energy. [10Hrs]

Unit II

Spectroscopic Techniques: Basic principles of spectroscopic methods. The use The use of various spectroscopic techniques for the determination of structure of simple compounds. XRD, SEM and TEM. [10Hrs]

Unit III

Polymers: Basic concepts & Terminology, such as monomers, Polymers, functionality, Thermoplastics, Thermosets, Linear, Branched, cross linked polymers etc. Different definitions of molecular weight's viz. Mw, Mn, Mv and then determinations, Industrial applications of polymers. General methods of synthesis of organics and their applications.

[10Hrs]

Unit IV

Nano Technology: Introduction, Properties, Synthesis and characterization of Nanomaterials, Material self-assembly, Nanoscale materials and their applications.

Biochemistry: Molecular basis of life, study of macro molecules: Carbohydrates, Proteins, Lipids, Nucleic acid. Metabolism, basic concepts and design, Glycolysis citric acid cycle oxidative phosphorylation pentose phosphate pathway..

[10Hrs]

Textbooks/References:

1. *Engineering Chemistry (16th Edition) by Jain, Jain, Dhanpat Rai Publishing Company, 2013.*
2. *Textbook of Engineering Chemistry by Jaya Shree Anireddy, Wiley, 2017.*
3. *Engineering Chemistry* byE.R. Nagarajan and S. Ramalingam, Wiley, 2017.
4. *Biochemistry* by Lubert Stryer, Jeremy Berg, John Tymoczko, Gregory Gatto 9th Edition 2019. W H Freeman & Co.

PaperCode: BS106	Paper: Engineering Mathematics – II	L	T/P	C
PaperID: 99106		4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand Complex series methods.
2:	To understand Complex analysis
3:	To understand Fourier and Laplace methods
4:	To understand how to solve specific formulated engineering problems using PDE methods.

Course Outcomes (CO):

CO1:	Ability to use Complex series methods.
CO2:	Ability to use Complex analysis to solve formulated engineering problems
CO3:	Ability to use Fourier and Laplace methods to solve formulated engineering problems
CO4:	Ability to solve specific formulated engineering problems using PDE methods.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	3	3	3	1	-	-	-	-	-	1	2
CO2	2	3	3	3	1	-	-	-	-	-	2	2
CO3	2	3	3	3	1	-	-	-	-	-	2	2
CO4	2	3	3	3	1	-	-	-	-	-	2	2

Unit I

Complex Analysis – I : Complex Numbers and Their Geometric Representation, Polar Form of Complex Numbers. Powers and Roots, Derivative. Analytic Function, Cauchy–Riemann Equations. Laplace's Equation, Exponential Function, Trigonometric and Hyperbolic Functions. Euler's Formula, de'Moivre's theorem (without proof), Logarithm. General Power. Principal Value**.**Singularities and Zeros. Infinity,

Line Integral in the Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivatives of Analytic Functions, Taylor and Maclaurin Series. [10Hrs]

Unit II

Complex Analysis – II: Laurent Series, Residue Integration Method. Residue Integration of Real Integrals,

Geometry of Analytic Functions: Conformal Mapping, Linear Fractional Transformations (Möbius Transformations), Special Linear Fractional Transformations, Conformal Mapping by Other Functions, Applications: Electrostatic Fields, Use of Conformal Mapping. Modeling, Heat Problems, Fluid Flow. Poisson's Integral Formula for Potentials

[10Hrs]

Unit III

Laplace Transforms: Definitions and existence (without proof), properties, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals and ODEs, Unit Step Function (Heaviside Function).Second Shifting Theorem (t-Shifting), Short Impulses. Dirac's Delta Function. Partial Fractions, Convolution. Integral Equations, Differentiation and Integration of Transforms. Solution of ODEs with Variable Coefficients, Solution of

Systems of ODEs. Inverse Laplace transform and its properties.

Fourier Analysis: Fourier Series, Arbitrary Period. Even and Odd Functions. Half-Range Expansions, Sturm–Liouville Problems. Fourier Integral, Fourier Cosine and Sine Transforms, Fourier Transform. Usage of fourier analysis for solution of ODEs. Inverse Fourier transform and its properties. [10Hrs]

Unit IV

Partial Differential Equations (PDEs): Basic Concepts of PDEs. Modeling: Vibrating String, Wave Equation. Solution by Separating Variables. Use of Fourier Series. D'Alembert's Solution of the Wave Equation. Characteristics. Modeling: Heat Flow from a Body in Space. Heat Equation:Solution by Fourier Series.Steady Two-Dimensional Heat Problems. Dirichlet Problem. Heat Equation: Modeling Very Long Bars.Solution by Fourier Integrals and Transforms. Modeling: Membrane, Two-Dimensional Wave Equation. Rectangular Membrane. Laplacian in Polar Coordinates. Circular Membrane. Laplace's Equation in Cylindrical and Spherical Coordinates. Potential. Solution of PDEs by Laplace Transforms. [10Hrs]

Textbooks:

1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th Ed., 2011.

References:

1. *Engineering Mathematics* by K.A. Stroud withDexter J. Booth, Macmillan, 2020.

2. *Advanced Engineering Mathematics* by Larry Turyn, Taylor and Francis, 2014.
3. *Advanced Engineering Mathematics* by Dennis G. Zill, Jones & Bartlett Learning, 2018.
4. *Advanced Engineering Mathematics with MATLAB* by Dean G. Duffy, Taylor and Francis, 2017.
5. *Advanced Engineering Mathematics* by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland), 2019.
6. *Mathematical Methods for Physics and Engineering*, by K. F. Riley, M. P. Hobson and S. J. Bence, CUP, 2013.

PaperCode: BS108	Paper: Engineering Physics - ll	L	T/P	C
PaperID: 99108		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To learn about the quantum nature of reality.
2:	To learn about quantum statistics and its significance.
3:	To learn about the band theory of solids and properties and characteristics of diodes.
4:	To understand the basics of physical basis of biology.

Course Outcomes (CO):

CO1:	Understand and appreciate the quantum nature of reality.
CO2:	Understand quantum statistics and its significance.
CO3:	Understand the band theory of solids and properties and characteristics of diodes.
CO4:	To have an understanding of the physical basis of Biology.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Quantum Mechanics: Introduction: Wave particle duality, de Broglie waves, the experiment of Davisson and Germer, electron diffraction, physical interpretation of the wave function, properties, the wave packet, group and phase velocity, the uncertainty principle . The Schrödinger wave equation (1D), Eigen values and Eigen functions, expectation values, simple Eigen value problems – solutions of the Schrödinger's equations for the free particle, the infinite well, the finite well, tunneling effect, the scanning electron microscope, the quantum simple harmonic oscillator (qualitative), zero point energy.

[12Hrs]

Unit II

Quantum Statistics: The need for statistics , statistical distributions: Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac statistics, their comparisons, Fermions and Bosons, Applications of quantum statistics: 1. Molecular speed and energies in an ideal gas; 2. The Black body spectrum, the failure of classical statistics to give the correct explanations – Bose-Einstein statistics applied to the Black Body radiation spectrum; Fermi-Dirac distribution, free electron theory, electronic specific heats, Fermi energy and average energy; Dying stars. [12Hrs]

Unit III

Band Theory of Solids: Origin of energy bands in solids, motion of electrons in a periodic potential – the Kronig–Penny model (Qualitative). Brillouin zones, effective mass, metals, semi-conductors and insulators and their energy band structures. Extrinsic and Intrinsic semiconductors, doping – Fermi energy for doped and undoped semiconductors, the p-n junction (energy band diagrams with Fermi energy), the unbiased diode, forward and reverse biased diodes – tunnel diodes, zener diode, photo diode its characteristics, LED [12Hrs]

Unit IV

Introduction to Physics in Biology: Overview : from molecules to life - the building blocks of biology, DNA Packing and Structure, The relationship between shape and function of biomolecules, Numbers and Sizes, System Variability and Spatial Scales, Timescales in Biological Systems [4Hrs]

Textbooks:

1. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury,McGraw – Hill, 2017.
2. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.

References:

1. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017
2. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.
3. *Solid State Electronic Devices ,by* Streetman and Ben G Prentice Hall India Learning Private Limited; 2006

4. https://drive.google.com/file/d/169AQBvIzHzbRjZU6M8oe260ZUWp7iUm1/view [part of NPTEL Lectures https://nptel.ac.in/courses/115/101/115101121/#

PaperCode: BS110	Paper: Probability and Statistics for Engineers	L	P	C
PaperID: 99110		3	2	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 50 marks
3. Term end Practical Examinations: 25 marks

Instruction for paper setter (Term end Theory Examinations):

1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand probability and probability distributions.
2:	To understand methods of summarization of data.
3:	To understand and use test for hypothesis.
4:	To understand methods for design experiments and analysis.

Course Outcomes (CO):

CO1:	Ability to solve probability problems and describe probability distributions.
CO2:	Ability to describe and summarize data.
CO3:	Ability to use test for hypothesis.
CO4:	Ability to design experiments and analyse using ANOVA.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	3	1	1	1	-	-	-	-	-	1	2
CO2	-	3	1	1	1	-	-	-	-	-	1	2
CO3	-	3	2	2	1	-	-	-	-	-	2	2
CO4	-	3	3	3	1	-	-	-	-	-	2	2

Unit I

Basics: Probability and Statistical models, Sample Spaces and Events, Counting Techniques, Interpretations and Axioms of Probability, Unions of Events and Addition Rules, Conditional Probability, Intersections of Events and Multiplication and Total Probability Rules, Independence, Bayes' Theorem, Random Variables.

Discrete and Continuous Random Variables and Distributions: Probability Distributions and Probability Mass / density Functions, Cumulative Distribution Functions, Mean and Variance of a Random Variable, Discrete and continuous Uniform Distribution, Binomial Distribution, Geometric and Negative Binomial Distributions, Hyper geometric Distribution, Poisson Distribution. Normal Distribution, Normal Approximation to the Binomial, and Poisson Distributions; Exponential Distribution, Erlang and Gamma Distributions, Weibull Distribution, Lognormal Distribution, Beta Distribution.

[10Hrs]

Unit II

Joint Probability Distributions for Two Random Variables, Conditional Probability Distributions and Independence, Joint Probability Distributions for Two Random Variables, Covariance and Correlation, Common Joint Distributions, Linear Functions of Random Variables, General Functions of Random Variables, Moment-Generating Functions.

Numerical Summaries of Data, Stem-and-Leaf Diagrams, Frequency Distributions and Histograms, Box Plots, Time Sequence Plots, Scatter Diagrams, Probability Plots. Point Estimation, Sampling Distributions and the Central Limit Theorem without proof, General Concepts of Point Estimation, Methods of Point Estimation, Statistical Intervals for a Single Sample.

[10Hrs]

Unit III

Hypotheses Testing for a Single Sample: Tests on the Mean of a Normal Distribution with Variance Known / Unknown, Tests on the Variance and Standard Deviation of a Normal Distribution, Tests on a Population Proportion, Testing for Goodness of Fit, Nonparametric tests (Signed, Wilcoxon), Similarly Statistical Inference for Two Samples.

Regression and Correlation: Linear Regression, Least Squares Estimators, Hypotheses testing for simple linear regression, Confidence Intervals, Adequacy of model, Correlation, Transformed Variables, Logistic Regression. Similarly, for multiple linear regression including aspects of MLR. [10Hrs]

Unit IV

ANOVA and Design of experiments: Designing Engineering Experiments, Completely Randomized Single-Factor Experiment, The Random Effects Model, Randomized complete block design, Concept of Factorial Experiments, Two Factor Factorial Experiments, General Factorial Experiments, 2^k Factorial Designs, Response Surface Methods and Designs. SQC: Quality improvement and Statistics, Control Charts including $\bar{X}$ and R or S charts, P and U charts, time weighted charts.

[10Hrs]

Note: Atleast two laboratory practicals in each unit to be conducted. The list of practicals to be notified by the concerned teacher to the school where the students are admitted at the start of the teaching in the semester.

Textbooks:

1.*Applied Statistics and Probability for Engineers* by Douglas G. Montgomery and Runger, Wiley, 2018

References:

1. *Miller and Freund's Probability and Statistics for Engineers* by Richard A. Johnson, Pearson, 10th Ed., 2018.
2. *Probability & Statistics for Engineers & Scientists* by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Pearson, 2016.
3. *Statistics and probability with applications for engineers and scientists using Minitab, R and JMP*, C. Gupta, Irwin Guttman, and Kalanka P. Jayalath, Wiley, 2020.
4. *Probability and Statistics for Engineering and the Sciences*, Jay Devore, Cengage Learning, 2014.
5. *Probability and Statistics in Emgineering*, William W. Hines, Douglas C. Montgomery, David M. Goldman, and Connie M. Borror, Wiley, 2003.

PaperCode: ICT114	Paper: Human Values and Ethics	L	P	C
PaperID: 164114		1	-	1

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, the examinations are to be conducted by the concerned teacher.

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives:

1:	To help students regulate their behavior in a professional environment as employees
2:	To make students aware of the impact of taking non-ethical engineering decisions.
3:	To understand that mind and desire control is needed for being ethical.
4:	To understand organizational culture and to adapt to varying cultures without compromising ethical values

Course Outcomes (CO):

CO1:	Realize the importance of human values.
CO2:	Understand that excessive desires of the mind make a person unethical and restless, while fewer desires lead to peace and professional progress
CO3:	Assess different types of risks involved in unethical practices. Know various means of protesting against unethical practices.
CO4:	Assess the benefits of restraining from unethical practices like bribery, extortion, nepotism, nexus between politicians and industrialists.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	3	-	3	1	1	-	1
CO2	-	-	-	-	-	3	-	3	1	1	-	1
CO3	-	-	-	-	-	3	-	3	1	1	-	1
CO4	-	-	-	-	-	3	-	3	1	1	-	1

Unit I

Human Values: Morals, Values, Ethics, Integrity, Work ethics, Service learning, Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the work place, Spirituality [3Hrs]

Unit II

Engineering Ethics: Senses of engineering ethics, Variety of moral issues, Types of inquiries, Moral dilemma, Moral autonomy, Moral development (theories), Consensus and controversy, Profession, Models of professional roles, Responsibility, Theories about right action (Ethical theories), Self-control, Self-interest, Customs, Religion, Self-respect, Case study: Choice of the theory

Engineering as experimentation, Engineers as responsible experimenters, Codes of ethics, Industrial standards, A balanced outlook on law, Case study: The challenger [3Hrs]

UnitIII

Safety definition, Safety and risk, Risk analysis, Assessment of safety and risk, Safe exit, Risk-benefit analysis
Sefety lessons from 'the challenger', Case study: Power plants, Collegiality and loyalty, Collective bargaining,
Confidentiality, Conflict of interests, Occupational crime, Human rights, Employee rights, Whistle blowing, Intellectual property rights. [4Hrs]

UnitIV

Globalization, Multinational corporations, Environmental ethics, Computer ethics, Weapons development, Engineers as managers, Consulting engineers, Engineers as expert witness, Engineers as advisors in planning and policy making, Moral leadership, Codes of ethics, Engineering council of India, Codes of ethics in Business Organizations
[3Hrs]

Textbooks:

1. *A Textbook on Professional Ethics and Human Values*, by R. S. Naagarazan, New Age Publishers, 2006.

References:

1. *Professional Ethics and Human Values* by D. R. Kiran, McGraw-Hill, 2014.
2. *Engineering Ethics, by Charles E Harris and Micheal J Rabins, Cengage Learning Pub., 2012.*
3. *Ethics in Engineering, Mike Martin and Roland Schinzinger, McGraw Hill Pub., 2017.*
4. *Unwritten laws of Ethics and Change in Engineeringby The America Society of Mechanical Engineers, 2015.*
5. *Engineering Ethics by Charles B. Fleddermann, Pearson, 2014.*

6. *Introduction to Engineering Ethics* by Mike W. Martin and Roland Schinzinger, McGraw-Hill, 2010.
7. *Engineering Ethics: Concept and Cases* by Charles E. Harris, Michael S. Pritchard and Michael J.Rabins, Cengage, 2009.
8. *Ethics in Engineering Practiceand Research* by Caroline Whitbeck, Cambridge University Press, 2007.

PaperCode: EMES112	Paper: Environmental Studies	L	P	C
PaperID: 99112		4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	The course is designed to impart basic knowledge of the environment and its components.
2:	The course deals in creating awareness about the energy resources and current environmental problems faced by the world.
3:	To understand and learn about environment pollution, related case studies and measures taken for control to pollution.
4:	To understand and explore different approaches of conserving and protecting environment for the benefit of society.

Course Outcomes (CO):

CO1:	Environmental Studies course will provide necessary information and knowledge about the various aspects of environment, ecosystems and related biodiversity.
CO2:	Students will be able to learn and understand about the availability and sustainable use of resources, environmental problems and their short term and long term impacts to humans.
CO3:	Course will help them to learn about environmental policies and protocols, social issues and role of human in conservation and protection of environment.
CO4:	Overall, course will help students to develop skills and ability of understanding environment- human relationship.

Course Outcomes (CO to Programme Outcomes (PO)) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	1	1	-	-	2	3	2	1	1	1	1
CO2	-	1	1	-	-	2	3	2	1	1	1	1
CO3	-	1	1	-	-	2	3	2	1	1	1	1
CO4	-	1	1	-	-	2	3	2	1	1	1	1

Unit I

Fundamentals:The Multidisciplinary nature of environmental studies: Definition, components, scope and importance, need for public awareness;

Ecosystems: Concept, Structure and function of an ecosystem, energy flow in ecosystems, food chain, food web, ecological pyramids, ecological succession; Introduction to types, characteristics features, structure and function of different ecosystems including forest, grassland, desert and aquatic ecosystem;

Biodiversity: Introduction to biodiversity-definition, genetics, species, ecosystem diversity, biogeographical classification of India, value of biodiversity-consumptive uses, productive, social, ethical, aesthetic and option values, biodiversity at global, national and local level, India as a mega diversity nation, endangered and endemic species of India, hot spots of biodiversity, threats to biodiversity – habitat loss, poaching of wild life, man wildlife conflicts and conservation of biodiversity- in-situ and ex-situ conservation. [16Hrs]

Unit II

Renewable and Non-renewable Resources:Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources-green fuel.

Water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems

Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forest and tribal people, case studies

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies

Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of individual in conservation of natural resources, Resource Management-Sustainable development.

[8Hrs]

Unit III

Environmental Pollution: (a) Air Pollution: Types of pollutants, source, effects, sink & control of primary pollutants– CO, NOX, HC, SOx and particulates, effect of pollutants on man & environment: photochemical smog, acid rain and global warming, CO2 Sequestration. (b) Water Pollution: Classification of Pollutants, their sources, waste water treatment (domestic and industrial). (c) Soil Pollution: Composition of soil, classification and effects of solid pollutants and their control. (d) Solid Waste Management: Classification, waste treatment and disposal methods; compositing, sanitary land filling, thermal processes, recycling and reuse methods. (e) Hazardous wastes - Classification, radioactive, biomedical & chemical, treatment and disposal- Physical, chemical and biological processes. (f) Marine Pollution: Causes, effects and control of marine pollution, coastal zone management (g) Thermal pollution: Causes, effects and control of marine pollution, coastal zone management.

Disaster Management: Floods, earth quake, cyclone and landslides [8Hrs]

Unit IV

Environmental Policies, Human Population and Environment

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, case studies; Some important Environmental laws, issues involved in enforcement of environment legislations, Green bench; carbon footprint, Montreal and Kyoto Protocol, conservation of Biological Diversity, The Chemical Weapons Convention, Environment Impact Assessment; population growth and variation among nations, Impacts on environment and human health, human right, Tribal people and rights, Human and wildlife conflicts in Indian context, Environmental ethics; Role of government and non government organizations in public awareness and environment improvement. [13Hrs]

Field work (equal to 5 hours) : visit to local areas to document environmental assets, study of simple ecosystems, study and identification of common plants, birds and insects.

Suggested Readings and References:

1. A textbook of environmental studies, R. Gadi, S. Rattan, S. Mohaptra, Kataria Publication, 2014.
2. Elements of environmental sciences & engineering, P. Meenakshi, PHI Learning Pvt Ltd, 2014.
3. Basics of Environment and Ecology, A. kaushik & C.P. Kaushik, New Age International Publishers, 2010.
4. Fundamental concepts in environmental studies, D.D. Mishra, S Chand & Co. Ltd., 2008.
5. Textbook of environmental studies, E. Barucha, UGC, 2005.
6. Environmental studies, B. Joseph, Tata McGraw-Hill Publishing Company Ltd., 2005.

PaperCode: ICT152	Paper: Engineering Graphics-II	L	P	C
PaperID: 164152		-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Course Objectives:

1:	The students will learn sectioning of solid figures.
2:	The students will understand 3D projections. They will have understanding of isometric and oblique projections.
3:	The students will have understanding of perspective projections,
4:	The students will learn computer aided drafting.

Course Outcomes (CO):

CO1:	Ability to draw sectional diagrams of solids
CO2:	Ability to draw 3S projections (isometric and oblique).
CO3:	Ability to draw perspective projections.
CO4:	Understand and use a CAD tool (AutoCAD).

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	2	1	2
CO2	3	3	3	3	2	-	-	-	1	2	1	2
CO3	3	3	3	3	2	-	-	-	1	2	1	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

Unit I

Section of Solids: Definition of Sectioning and its purpose, Procedure of Sectioning, Illustration through examples, Types of sectional planes-application to few examples.

Unit II

Isometric Projection: Classification of pictorial views, Basic Principle of Isometric projection, Difference between isometric projection and drawing, Isometric projection of solids such as cube, prism, pyramid and cylinder.
Oblique Projection: Principle of oblique projection, difference between oblique projection and isometric projection, receding lines and receding angles, oblique drawing of circle, cylinder, prism and pyramid.

Unit III

Perspective Projection: Principle of perspective projection, definitions of perspective elements, visual ray method, vanishing point method.
Conversion of 3D to 2D figures.

Unit IV

Introduction to CADD: Interfacing and Introduction to CAD Software, Coordinate System, 2D drafting: lines, circles, arc, polygon, etc., Dimensioning, 2-D Modelling, Use of CAD Software for engineering drawing practices.

Note: The sheets to be created shall be notified by the concerned teacher in the first week of teaching.

Textbooks:

1. *Engineering Drawing* by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat,2017.

References:

1. *Engineering Drawing*by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.
2. *Technical Drawing with Engineering Graphics* by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016
3. *Engineering Drawing*by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.
4. *AutoCAD 2017 for Engineers & Designers*by Sham Tickoo,, Dreamtech Press 2016.

PaperCode: BS156	Paper: Engineering Chemistry - II Lab.		L	P	C
PaperID: 99156			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:

1. The course objectives and course outcomes are identical to that of BA104 (Engineering Chemistry - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

PaperCode: BS158	Paper: Engineering Physics - II Lab.		L	P	C
PaperID: 99158			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:

1. The course objectives and course outcomes are identical to that of BA108 (Engineering physics - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

PaperCode: ICT154	Paper: Workshop Technology	L	P	C
PaperID: 164154		-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

Course Objectives:

1:	The students will learn basics of safety precautions to be taken in lab. / workshop
2:	The students will have an overview of different machines used in workshop and the operations performed on these machines.
3:	The students will have understanding of various welding processes.
4:	The students will have understanding of sheet metals hop and fitting shop

Course Outcomes (CO):

CO1:	Ability to safely work in a Lab./workshop.
CO2:	Ability to use machines (lathe, mill, shaper, planer, grinder, drill).
CO3:	Ability to weld.
CO4:	Ability to use sheet metal tools and fitting shop tools.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	1	2	2	3	3	-	-	-	-	-	2
CO2	2	1	2	2	3	1	-	-	-	-	-	2
CO3	2	1	2	2	3	1	-	-	-	-	-	2
CO4	2	1	2	2	3	1	-	-	-	-	-	2

Unit I

Safety, precautions and maintenance: Safety in shop, safety devices, safety and precautions - moving machine and equipment parts, electrical parts and connections, fire, various driving systems like chain, belt and ropes, electrical accidents, an overview of predictive, preventive and scheduled maintenance, standard guidelines to be followed in shop.

Unit II

Introduction to machine shop: Introduction to Lathe, Milling, shaper, Planer, grinder, drilling and overview of operations performed on these machines by making some jobs.

Unit III

Introduction to welding shop: Welding, types of welding, tools and applications, gas welding and arc welding, edge preparation, various joints formation by gas welding and electric arc welding.

Unit IV

Introduction to sheet metal shop: Sheet metal tools and operations, formation of a box using sheet.
Introduction to fitting shop: Introduction to fitting, tools and applications, some jobs in fitting shop.

Textbooks:

1. *Workshop Technology Vol. 1 and Vol. 2*, Hajra Choudhary and Roy, Media Promoters and Publishers, 2018.

References:

1. *A course in Workshop Technology Vol.1 and Vol. 2*, B. S. Raghuvanshi, Dhanpat Rai and Compnay, 2015.
2. *Workshop Technology (Manufacturing Processes)*, Khurmi and Gupta, S. Chand Publication, 2010.

PaperCode: ICT160	Paper: Programming in Python	L	P	C
PaperID: 164160			2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

Course Objectives:

1:	The students will learn the Programming in the Python Language
2:	The students will learn usage of language implemented data structures.
3:	The students shall learn the object oriented features of the Python Language.
4:	The students will learn usage of the Numpy, Panda and Matplotlib

Course Outcomes (CO):

CO1:	Ability to write procedural programmes in Python.
CO2:	Ability to write programs using standard data structures.
CO3:	Ability to use object oriented paradigm to write program in Python.
CO4:	Ability to use Numpy, Panda and Matplotlib modules to write programs.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	1	2	1	3	-	-	-	1	1	1	1
CO2	-	1	2	1	3	-	-	-	1	1	1	1
CO3	-	1	2	1	3	-	-	-	1	1	1	1
CO4	-	1	2	1	3	-	-	-	1	1	1	1

Unit I

Identifiers, keywords, statements & expressions, variables, operators, precedence & associativity, data types, indention, comments, console I/O, type conversion. Control flow statements (if family; while & for loops; continue & break statements), exception handling. Functions, command line arguments.

Unit II

String management & usage, Lists, Dictionaries, Tuples & Sets. The operations on these data structures. Filter, Map and Reduce Function,

Unit III

Object Oriented Programming: Properties / attributes, methods, inheritance, class variables & functions, static methods, delegation, abstract base classes, Generic function.
File Handling.

Unit IV

Numpy: Dtypes, Multidimensional Arrays, Slicing,Numpy Array & Memory, Array element-wise operations, Numpy Data I/O, floating point numbers, Advanced Numpy dtypes.
Pandas: Using series and Dataframes, Indexing &Reindexing, Deleting and merging items, Common operations, Memory usage and dtypes, Pipes, Displying dataframes, Rolling & Filling operations.
Matplotlib: Setting defaults, Legends, Subplots, Sharing Axes, 3D surfaces.

Note: Atleast two laboratory practicals in each unit to be conducted. The list of practicals to be notified by the concerned teacher at the start of the teaching in the semester.

Textbooks:

1. *Introduction to Python Programming*, Gowrishankar S. and Veena A., CRC Press, 2019.
2. *Python Programming for Data Analysis*, Jose Unpingco, Springer Nature, 2021.

References:

1. *Python: An Introduction to Programming*, James R. Parker, 2nd Ed., Mercury Learning And Information, 2021.
2. *Introduction to Computation and Programming Using Python*, John V. Guttag, The MIT Press, 2021.
3. *Python Programming: A Practical Approach*, Vijay Kumar Sharma, Vimal Kumar, Swati Pathak, and Shashwat Pathak, CRC Press, 2021.

PaperCode: ICT116	Paper: Introduction to Manufacturing Process	L	T/P	C
PaperID: 164116		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	The students will have basic understanding of various manufacturing processes. The students will have knowledge about casting process.
2:	The students will have understanding of joining processes.
3:	The students will have understanding of forging and sheet metal works.
4:	The students will have basic idea of powder metallurgy and manufacturing of plastic components.

Course Outcomes (CO):

CO1:	Understand casting process.
CO2:	Understand joining process.
CO3:	Understand forging and sheet metal work.
CO4:	Basic understanding of powder metallurgy and manufacturing of plastic components.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	1	1	1	2	-	-	-	-	-	1	1
CO2	2	1	1	1	2	-	-	-	-	-	1	1
CO3	2	1	1	1	2	-	-	-	-	-	1	1
CO4	2	1	1	1	2	-	-	-	-	-	1	1

Unit I

Definition of manufacturing, Importance of manufacturing towards technological and social economic development, Classification of manufacturing processes, Properties of materials.

Metal Casting Processes: Sand casting, Sand moulds, Type of patterns, Pattern materials, Pattern allowances, Types of Moulding sand and their Properties, Core making, Elements of gating system. Description and operation of cupola.

Working principle of Special casting processes - Shell casting, Pressure die casting, Centrifugal casting. Casting defects. [10Hrs]

Unit II

Joining Processes: Welding principles, classification of welding processes, Fusion welding, Gas welding, Equipments used, Filler and Flux materials. Electric arc welding, Gas metal arc welding, Submerged arc welding, Electro slag welding, TIG and MIG welding process, resistance welding, welding defects. [10Hrs]

Unit III

Deformation Processes: Hot working and cold working of metals, Forging processes, Open and closed die forging process. Typical forging operations, Rolling of metals, Principle of rod and wire drawing, Tube drawing. Principle of Extrusion, Types of Extrusion, Hot and Cold extrusion.

Sheet metal characteristics -Typical shearing operations, bending and drawing operations, Stretch forming operations, Metal spinning. [10Hrs]

Unit IV

Powder Metallurgy: Introduction of powder metallurgy process, powder production, blending, compaction, sintering

Manufacturing Of Plastic Components: Types of plastics, Characteristics of the forming and shaping processes, Moulding of Thermoplastics, Injection moulding, Blow moulding, Rotational moulding, Film blowing, Extrusion, Thermoforming. Moulding of thermosets- Compression moulding, Transfer moulding, Bonding of Thermoplastics.

[10Hrs]

Textbooks:

1. *Manufacturing Technology: Foundry, Forming and WeldingVolume 1*, P. N Rao, , McGrawHill, 5e, 2018.
2.*Elements of Workshop TechnologyVol. 1 and 2*by Hajra Choudhury, Media Promoters Pvt Ltd.,2008.

References:

1. *Manufacturing Processes for Engineering Materials*, by Serope Kalpajian and Steven R.Schmid, Pearson Education, 5e, 2014.
2. *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems* by Mikell P. Groover, John Wiley and Sons, 4e, 2010 .
3. *Production Technology* byR.K.Jain and S.C. Gupta, Khanna Publishers. 16th Edition, 2001.

PaperCode: BS118	Paper: Industrial Chemistry	L	T/P	C
PaperID: 99118		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	Learn about the functioning of drugs and dyes.
2:	Learn about the most important ways of preventing corrosion.
3:	Learn about the properties of heterocycles
4:	Learn about techniques of synthesis.

Course Outcomes (CO):

CO1:	Understand the functioning of drugs and dyes.
CO2:	Understand the most important ways of preventing corrosion.
CO3:	Understand the properties of heterocycles
CO4:	Understand techniques of synthesis.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	2	3	3	1	1	1	-	-	-	-	1
CO2	3	2	3	3	1	1	2	-	-	-	-	1
CO3	3	2	3	3	1	-	-	-	-	-	-	1
CO4	3	2	3	3	1	-	-	-	-	-	-	1

Unit I

Polymerization technology, dyes and drugs: classification of polymers, plastics, fibres, elastomers. Dyes: Requirements of a dye, chemical nature, classification, chemistry of representative important dyes. Pharmaceuticals: sulfa drugs, antipyretics and analgesics, antibiotics, antimalarials. Caustic soda & Chlorine. Hydrochloric acid. Sulphur & sulphuric Acid.

[10Hrs]

Unit II

Corrosion: Corrosion and its economic aspects, Thermodynamics of corrosion, Immunity, corrosivity and passivation. Mechanism and kinetics of Corrosion. Electrochemical methods for corrosion testing.

Corrosion Prevention Techniques: Metallic coatings, organic paints, varnishes, corrosion inhibitors, cathodic and anodic protection.

Corrosion Prevention Techniques: Metallic coatings, organic paints, varnishes, corrosion inhibitors, cathodic and anodic protection.

[10Hrs]

Unit III

Chemistry of Heterocyclic Compounds: Introduction, nomenclature, structures, and reactivities of heterocyclic compounds. Chemistry and reactivity of five and six membered heterocyclic compounds with one hetero atoms. Chemistry of selected industrially important heterocyclic compounds. [8Hrs]

Unit IV

Synthetic Methods: Introduction to synthesis, strategy of synthesis. Designing of green synthesis: choice of starting materials, reagents, catalysts and solvents. Basic principles of green chemistry and synthesis of organic compounds involving basic principles of green chemistry methodology of synthesis. New methods in organic synthesis: microwave technique, use of phase transfer catalyst in organic synthesis. [12Hrs]

Textbooks and References:

1. J.P. Mukhlyonov: Fundamentals of Chemical Technology.
2.M.G. Rao, M.Sittig: Dryden's out line of Chemicals Technology.
3.Emil Raymond Riegel: Industrial Chemistry.
4. Frank Hall Thorp: Outlines of Industrial Chemistry.
5.M.G. Fontana: Corrosion Engineering, McGraw Hill International Book Co. London.
6.L.L. Shreir: Corrosion, Vol I and Vol II, Newness Butterworths, Edward Arnold Ltd, London.
7.J.C. Scully: Fundamental of Corrosion, Pargmon Press Inc. New York, USA
8.J.A. Joule, K. Mills and G.F. Smith: Heterocyclic chemistry, III Ed., East West Press vt Ltd, ND.
9.A.R. Katrizky and J.A. Boulton: Advances in Heterocyclic chemistry, Vol 1-27, Academic Press, NY.
10.R.M. Achesion: An Introduction to the Chemistry of Heterocyclic Compounds, II Ed, NY.

PaperCode: BT120	Paper: Introduction to Biotechnology	L	T/P	C
PaperID: 160120		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To introduce different areas in Biotechnology to students, laying a foundation for future courses within our biotechnology programme.
2:	To provide a historical perspective of the growth and development of biotechnology, as well as its scope and importance.
3:	To help students understand the interdisciplinary nature of biotechnology, involving integration of several disciplines to generate knowledge and technology impacting society and environment.
4:	To sensitize students towards IPR, safety and ethical concerns in biotechnology research and applications.

Course Outcomes (CO):

CO1:	Understand the history, scope, interdisciplinary nature and significance of biotechnology.
CO2:	Understand the basics of recombinant DNA technology, protein structure and engineering, bioinformatics and principle(s) underlying basic biotechnological techniques.
CO3:	Describe the basics of culturing microbes, animal cells and plant cells in laboratory, and their respective applications in Biotechnology.
CO4:	Have an awareness about the IPR, safety and ethical issues involved in use of biotechnology.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	2	3	3	1	1	1	-	-	-	-	1
CO2	3	2	3	3	1	1	2	-	-	-	-	1
CO3	3	2	3	3	1	-	-	-	-	-	-	1
CO4	3	2	3	3	1	-	-	-	-	-	-	1

Unit I

Introduction: Historical perspective, Definition of Biotechnology; Areas of biotechnology; Scope; Importance and Commercial potential; Interdisciplinary nature;

Solutions and Buffers: Introduction to Solutions and Buffers; Modes of expressing concentration of a solution, Making solutions, Concept of pH and buffers, Henderson-Hasselbach equation, Criteria for selection of buffers;

[8Hrs]

Unit II

Recombinant DNA Technology: Tools of rDNA Technology; Making recombinant DNA; Introduction of recombinant DNA into host cells; Introduction to selection and screening techniques for identification of recombinants; Agarose Gel Electrophoresis; Principle, Steps and Applications of Polymerase Chain Reaction;

Protein Structure and Engineering: Introduction to the world of Proteins, Amino acids as building blocks, Non-covalent interactions, Structure of proteins, Structure Function relationship in Proteins, Recombinant proteins of high value, Introduction to Protein Engineering and Design, Introduction to Proteomics.

Introduction to basic techniques in Biotechnology: Beer-Lambert's Law, Spectrophotometer, Agarose Gel Electrophoresis, SDS-PAGE, Gel-Filtration Chromatography, Ion Exchange Chromatography, Affinity chromatography.

Introduction to Bioinformatics: Concept of Primary and Secondary databases, Nucleic acid and Protein databases, Introduction to sequence alignment, Applications of bioinformatics. [12Hrs]

Unit III

Microbial Biotechnology: Microbial Culture Techniques; Measurement and Kinetics of Microbial Growth; Scale up of microbial process; Isolation of microbial products; Strain Isolation; Improvement and Preservation;

Plant Biotechnology: History of plant tissue culture; Plant cell and tissue culture techniques; Transgenic plants with beneficial traits;

Animal Biotechnology: History of animal tissue culture; Animal Cell culture techniques; Finite and Continuous cell lines; Characterization of cell lines; Scale-up of animal cell culture; Applications of microbial, plant and animal biotechnology.

[12Hrs]

Unit IV

Biotechnology and Society: Introduction to Patenting; Criterion for patents; Reading a patent; National and International Patent Laws; Safety and Ethical issues in Biotechnology; Biotechnology in India and global trends; Product safety and marketing.

[8Hrs]

Text / Reference Books:

1. *Introduction to Biotechnology*, W.J. Thieman and M.A. Palladino, Pearson, 2019.
2. *Biotechnology Foundations*, J.O. Grady, 2019.
3. *Gene cloning and DNA Analysis. An introduction*. T. A Brown, Wiley-Blackwell Science, 2016.
4. *Concepts in Biotechnology: History, Science and Business*, K.Buchholz and J. Collins, Wiley-VCH, 2011.
5. *Biotechnology*, H.K. Das, 2010, Wiley Publishers.
6. *Biotechnology*, Smith, 2009, Cambridge Press.
7. *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson & Walker, Cambridge Press, 2008.

General Implementation Rules:

1. The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.

SCHEME OF EXAMINATION

Year 2-4

(3rd to 8th Semester)

for

B. Tech. in Biotechnology

2021 onwards

UNIVERSITYSCHOOLOF BIOTECHNOLOGY

GGSINDRAPRASTHAUNIVERSITY

Sector16-C,Dwarka,NewDelhi-110078

*Approved in the Academic Council sub-committee meeting on……..

Year2

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Theory Papers					
PC	BT-	Microbiology	3	1	4
PC	BA-	Biochemistry	3	1	4
PC	BT-	Cell Biology	3	1	4
PC	BT-	Genetics	3	1	4
PC	CT-	Introduction to material and energy balance	3	1	4
Practical/Viva Voce					
PC	BT	Genetics-Lab	0	3	1.5
PC	CT-	Introduction to material and energy balance Lab	0	3	1.5
PC	BT-	Cell Biology–Lab	0	3	1.5
PC	BT-	Microbiology Lab	0	3	1.5
PC	BA	Biochemistry Lab	0	3	1.5
NUES*		NCC/NSS/YFE and other activities	0	2	2
Total			**15**	**22**	**29.5**

***NUES: Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, outo f 100. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester.**

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Theory Papers					
PC	BT-	Immunology and Immunotechnology	3	1	4
PC	BT-	Molecular Biology	3	1	4
PC	BT-	Enzyme Technology	3	1	4
PC	BT-	Techniques in Biotechnology	3	1	4
PC	CT-	Fundamentals of Heat and Mass Transfer	3	1	4
Practical/Viva Voce					
PC	BT-	Molecular Biology–Lab	0	3	1.5
PC	BT-	Enzyme Technology–Lab	0	3	1.5
PC	BT-	Immunology and Immunotechnology–Lab	0	3	1.5
PC	BT-258	Techniques in Biotechnology Lab	0	3	1.5
Total			**15**	**17**	**26**

Year3

Fifth Semester					
Code	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Theory Papers					
PC	BT-	Animal Biotechnology	3	1	4
PC	BT	Unit operations and plant design for biomanufacturing	3	1	4
PC	BT	Plant Biotechnology	3	1	4
PC	BT-	Recombinant DNA Technology	3	1	4
*PCE/ ***EAE		*Professional Core elective- / Electivein Emerging Areas #	3	1	4
**OAE		**Open area elective offered by USBT-1 or Elective from other schools #	3	1	4
Practical/Viva Voce					
PC	BT-	Animal tissue Culture–Lab	0	3	1.5
PC	BT	Unit operations and plant design for biomanufacturing Lab	0	3	1.5
PC	BT	Plant Biotechnology –Lab	0	3	1.5
PC	BT-363	Recombinant DNA Technology Lab	0	3	1.5
Total			**18**	**18**	**30**

***PCE: Professional Core Elective-1 (Anyone) #**

		L	**T/P**	**Credits**
PCE-1	Subject choice will be provided			
PCE-1	Subject choice will be provided			

****OAE: Open Area Electives- 1 Offered by USBT (Anyone)#**

		L	**T/P**	**Credits**
OAE	Subject choice will be provided			
OAE	Subject choice will be provided			
	MOOCs (Only Govt. approved platforms like SWAYAM, nptel, e-P G Pathshala etc.)			4

*****EAE: Emerging Area Elective – 1 offered by USBT (students to select anyone)#**

		L	**T/P**	**Credits**
EAE1-BT	Subject choice will be provided			
EAE1-BT	Subject choice will be provided			

The courses for Professional Core Elective / Open Area Elective / Emerging Area Elective will be added before commencement of the semester.

Year 3 (cont..)

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Theory Papers					
PC	BT-	Bioinformatics	3	1	4
PC	BT-	Intellectual Property Rights, Biosafety And Bioethics In Biotechnology	3	1	4
PC	BT-	Downstream Processing	3	1	4
PC	BT-	Bioprocess Engineering	3	1	4
PCE-2*/EAE-2***		Food and Nutrition Technology	3	1	4
OAE-2**		Plant secondary metabolites and their multiple Applications	3	1	4
Practical / Viva Voce					
PC	BT-	Bioinformatics–Lab	0	3	1.5
PCE	BT-	Food and Nutrition Technology Lab	0	3	1.5
PC	BT-	Bioprocess Engineering-Lab	0	3	1.5
Total			**18**	**15**	**28.5**

***PCE: Professional Core Elective - 2 (anyone) #**

		L	**T/P**	**Credits**
PCE-2	Food and Nutrition Technology	3	1	4
PCE-2	Food and Nutrition Technology (lab)	0	3	1.5

****Open Area Elective – 2 (anyone)#**

		L	**T/P**	**Credits**
OAE2-BT	Plant secondary metabolites and their multiple applications	3	1	4
OAE	Subject choice will be provided			
	MOOCs (Only Govt. approved platforms like SWAYAM, nptel, e-PG Pathshala etc.)			4

#Additional courses for Professional Core Elective / Open Area elective / Emerging Area Elective will be added before commencement of the semester.

Year4

Seventh Semester					
Group	Paper Code	Paper	L	T/P	Credits
Theory Papers					
PC	BT-	Environmental Biotechnology	3	1	4
PC	BT-	Genome engineering and editing	3	1	4
PCE-3*	BT-	Protein Biotechnology	3	1	4
PCE-4**	BT-	Computational Biology	3	1	4
OAE-3***		***Open areaelective-3#	3	1	4
Practical/VivaVoce					
PC	BT-	Genome engineering and editing		3	1.5
PC	BT-	Environmental Biotechnology–Lab	0	3	1.5
PCE-3	BT-	Protein Biotechnology–Lab	0	3	1.5
PCE-4	BT-	Computational Biology Lab	0	3	1.5
Total			**15**	**17**	**26**

***PCE:ProfessionalCoreElective-3:(Anyone) #**

		L	**T/P**	**Credits**
PCE-3	Protein Biotechnology	3	1	4
PCE-3	Protein Biotechnology–Lab	0	3	1.5
****ProfessionalCoreElectives-4:(Any one)#**				
PCE-4	Computational Biology	3	1	4
PCE-4	Computational Biology Lab	0	3	1.5

*****OAE: Open AreaElectives-3(Anyone) #**

		L	**T/P**	**Credits**
OAE-3BT	Plant Stress Biology	3	1	4
OAE-3BT	Research Methodology and IPR	3	1	4
OAE-3BT	R programming for data analysis	3	1	4
	MOOCs (Only Govt. approved platforms like SWAYAM, nptel, e-PG Pathshala etc.)			4

Additional courses of Professional Core Elective / Emerging Area Elective will be added before commencement of the semester.

[4]

Year 4 (cont…)

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Practical/Viva Voce%					
	BT-	*Project Work			12
	BT-	**Journal Club / Seminar			2
Total					**14**

%*By default every student shall do a project work under the supervision of USBT faculty.
Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor and 60 marks by an external examiner deputed by examinations division (COE) for a total of 100 marks.
**Evaluation shall be conducted for 40 marks (Teachers' continuous evaluation / internal assessment) by appointed teacher and for 60 marks by a bench comprising of all faculty and an external examiner deputed by examinations division (COE) for a total of 100 marks.

In the absence of any supervisor / faculty Dean of the school can assign responsibility of the supervisor (for purpose of examinations) to any faculty of the school.

Note:

1) The programme of study shall be governed by ordinance 11 of the university.
2) Total credits for B. Tech. in Biotechnology (1-8 semesters):212
3) Minimum credits required: 200