

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,  
CHHATRAPATI SAMBHAJINAGAR.**



**CIRCULAR NO.SU/Sci./University Deptt./NEP/02/2024**

It is hereby inform to all concerned that, the syllabi prepared by The Departmental Committee and recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 05 June 2024 has accepted** the following Syllabi under the Faculty of Science & Technology **as per Norms of National Education Policy – 2020 run at University Department, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapathi Sambhajinagar** as appended herewith.

Sr.No.	Syllabi of the Department.	Semester
1.	Revised B.Tech. (Chemical) Food Technology	Ist and IInd Semester.
2.	Revised B.Tech. (Chemical) Pharmaceutical & Fine Chemicals Technology	Ist and IInd Semester.
3.	Revised M.Tech. (Chemical) Drugs & Pharmaceuticals	Ist and IInd Semester.
4.	Revised M.Sc. Food Technology	Ist and IInd Semester.

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus, \*  
Chhatrapati Sambhajinagar - 431 004. \*  
REF.NO.SU/NEP/2024/892-900 \*  
Date:- 18.06.2024. \*

  
**Deputy Registrar,  
Academic Section.**

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**Copy forwarded with compliments to :-**

- 1] **Head of the Department, Department of Chemical Technology,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 2] **The Director, University Network & Information Centre, UNIC,** with a request to upload this Circular on University Website.

**Copy to :-**

- 1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 2] The Section Officer,[M.Sc.,Engg. Unit,] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

**Dr. Babasaheb Ambedkar Marathwada University,**

**Chhatrapati Sambhajinagar-431004 (MS), India**

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**B. TECH (CHEMICAL)**  
**PHARMACUETICALS & FINE CHEMICALS TECHNOLOGY**

**Revised Program Structure and Detail Syllabus**

*(In line with New Education policy 2020)*

**(Effective from Academic Year 2024-2025 & onwards)**

Department of Chemical Technology

*Prakar*

Chairman

Adhoc Board in Chemical Technology

## Department of Chemical Technology

*In line with New Education Policy 2020*

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course	BSC/ESC	06-08	08-10		--	--	--	--	--	14-18
Engineering Science Course		10-08	06-04		--	--	--	--	--	16-12
Programme Core Course (PCC)	Program Courses	--	02	08-10	08-10	10-12	08-10	04-06	04-06	44-56
Programme Elective Course (PEC)		--	--	--	--	04	08	02	06	20
Multidisciplinary Minor (MD M)	Multidisciplinary Courses		-	02	02	04	02	02	02	14
Open Elective (OE) Other than a particular program		--	--	04	02	02	--	--	--	08
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02	02	--	02	--	02	--	--	08
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	02	--	--	02	--	--	--	--	04
Entrepreneurship/Economics/Management Courses		--		02	02	--	--	--	--	04
Indian Knowledge System (IKS)			02		--	--	--	--	--	02
Value Education Course (VEC)		--	--	02	02	--	--	--	--	04
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--		04	04
Comm. Engg. Project (CEP)/Field Project (FP)		--	--	02	--	--	--	-	-	02
Project		--	--	--	--	--	--		04	04
Internship/ OJT		--	--			--	--	12	-	12
Co-curricular Courses (CC)	Liberal Learning Courses	02	02		--	--	--	--	-	04
<b>Total Credits (Major)</b>		<b>20-22</b>	<b>20-22</b>	<b>20-22</b>	<b>20-22</b>	<b>20-22</b>	<b>20-22</b>	<b>20-22</b>	<b>20-22</b>	<b>160-176</b>

## Course Structure for Chemical Technology

### Semester-I (First Year)

Course Code	Course Title	Hours per week					Evaluation Scheme						Credits	Categorization
		L	T	P	Total	CT	TA	PR	ESE	Total				
2021BS101	Chemistry-I	3	0	0	3	40	0	0	60	100			3	BSC
2021BS102	Chemistry-I (Lab)	0	0	4	4	0	20	30	0	50			2	BSC
2021BS103	Biology for Engineering	2	0	0	2	20	0	0	30	50			2	BSC
2021BS104	Mathematics-I	3	0	0	3	40	0	0	60	100			3	BSC
2021ES101	Engineering Graphics	3	0	0	3	40	0	0	60	100			3	ESC
2021ES102	Engineering Graphics (Lab)	0	0	4	4	0	20	30	0	50			2	ESC
2021ES103	Environmental Science	2	0	0	2	20	0	0	30	50			2	ESC
2021SE101	Laboratory Skills	0	0	2	2	0	20	30	0	50			1	VSEC
2021AE101	Development of Skills-I	0	0	4	4	0	20	30	0	50			2	AEC/VEC/IKS
2021CC101	Sports & Fitness	0	0	4	4	0	20	30	0	50			2	CC
	<b>Total</b>	<b>13</b>	<b>0</b>	<b>18</b>	<b>31</b>	<b>160</b>	<b>100</b>	<b>150</b>	<b>240</b>	<b>650</b>			<b>22</b>	

*Prakash*

## Semester-II (First Year)

Course Code	Course Title	Hours per week					Evaluation Scheme					Credits	Categorization
		L	T	P	Total	CT	TA	PR	ESE	Total			
2021BS105	Chemistry-II	2	0	0	2	20	0	0	30	50		2	BSC
2021BS106	Chemistry-II (Lab)	0	0	2	2	0	10	15	0	25		1	BSC
2021BS107	Physics	1	0	0	1	10	0	0	15	25		1	BSC
2021BS108	Physics (Lab)	0	0	2	2	0	10	15	0	25		1	BSC
2021BS109	Mathematics-II	3	0	0	3	30	0	0	45	75		3	BSC
2021ES104	Engineering Applications of Computer	1	0	0	1	10	0	0	15	25		1	ESC
2021ES105	Engineering Applications of Computer (Lab)	0	0	2	2	0	20	30	0	50		1	ESC
2021ES106	Basic Mechanical Engineering	3	0	0	3	30	0	0	45	75		3	ESC
2021ES107	Basic Mechanical Engineering (Lab)	0	0	2	2	0	10	15	0	25		1	ESC
2021PC101	Dosage Form Technology	2	0	0	2	20	0	0	30	50		2	PCC
2021SE102	Professional Lab Practices	1	0	0	1	10	0	0	15	25		1	VSEC
2021SE103	Professional Lab Practices (Lab)	0	0	2	2	0	10	15	0	25		1	VSEC
2021AE102	Indian Knowledge System- Indian Health, Wellness & Psychology (including Ayurveda)	2	0	0	2	20	0	0	30	50		2	AEC/VEC/IKS
2021CC102	Yoga and Meditation	0	0	4	4	0	20	30	0	50		2	CC
	<b>Total</b>	<b>15</b>	<b>0</b>	<b>14</b>	<b>29</b>	<b>150</b>	<b>80</b>	<b>120</b>	<b>225</b>	<b>575</b>		<b>22</b>	

*DR. WAKO.*

2021BS101	Chemistry-I	3L:0T:0P	3 credits
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**Course Objectives:**

The learning objectives of Chemistry-I are

1. To understand quantum chemistry, atomic orbital
2. To understand coordination chemistry and its applications relevance to bio-inorganic chemistry
3. To understand the nomenclature of aromatic compounds and aliphatic compounds
4. To understand stereochemistry and its applications

**Course Outcomes:**

After completion, the students will able to

1. Appreciate quantum theory of chemical systems
2. Write nomenclature of organic compounds
3. Appreciate stereochemistry
4. Write simple mechanisms

**Unit 1: Introduction to quantum theory for chemical systems:** Schrodinger equation, Application to Hydrogen atom, Atomic orbitals, many electron atoms (6 L)

**Unit 2: Chemical bonding in molecules:**

MO theory, Structure, bonding and energy levels of bonding and shapes of many atom molecules, Coordination Chemistry, Electronic spectra and magnetic properties of complexes with relevance to bio-inorganic chemistry, organometallic chemistry(6 L)

**Unit 3: Nomenclature of organic compounds: Aliphatic, Aromatic (6 L)**

**Unit 4: Introduction of stereochemistry: Stereodescriptors – R, S, E, Z. Enantiomers and Diastereomers. Racemates and their resolution. Conformation of cyclic and acyclic systems. (9 L)**

**Unit 5: Reactivity of organic molecules:** factors influencing acidity, basicity, and nucleophilicity of molecules, kinetic vs. thermodynamic control of reactions (9L)

**Unit 6: Strategies for synthesis of organic compounds,** Generation, Stability and reactions of reactive intermediates. Aliphatic and Aromatic substitution reaction. E1, E2 Elimination

reaction. Electro rich and electron deficient rearrangements, kinetics and thermodynamic aspects, role of solvents (12L)

**Total – 48 (L)**

#### **Text Books**

1. R.T. Morrison and R.N. Boyd “Organic Chemistry” VI Edition Prentice Hall Inc (1996) USA.
2. K.S. Tiwari, N.K. Vishnoi and S.N. Malhotra “A text book of Organic Chemistry” Second Edition, Vikas Publishing House Pvt. Ltd. (1998) New Delhi.
3. P.W. Atkins, Elements of Physical Chemistry, 4th Edition, Oxford University Press
4. C.N. Banwell and E. M. MacCash, Fundamentals of Molecular Spectroscopy, 5th Edition, 29
5. P.K. Kar, S.Dash and B.Mishra, B.Tech. Chemistry Vol. I, Kalyani Publications

#### **Reference books**

1. Chemistry in Engineering and Technology, Vol.2, TMH Publishing Co Ltd., New Delhi, 1994.
2. I L Finar “Organic Chemistry” ELBS (1994).

<b>2021BS102</b>	<b>Chemistry-I (Lab)</b>	<b>0L:0T:4P</b>	<b>2 credits</b>
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**Course Objectives:**

The learning objectives of Chemistry-I laboratory are

1. To learn Melting and Boiling Point, element Detection and identification of unknown Organic Compounds
2. To synthesize and learn the process
3. To know the oxidation, Reduction , Acylation, Esterification

**Course Outcomes:**

After completion, Students will able to

1. Identify organic compounds
2. Synthesize organic compounds
3. know Acylation, Oxidation and Esterification.

**EXPERIMENTS:**

1. 10-12 experiments to illustrate the concept learnt in chemistry-I (No. of lab Hrs – 2) perexperiments (24 P)
  - Suitable experiments from following category
  - Identification of organic compounds through element detection, functional group detection, physical constants (M.P., B.P)
2. Synthesis of organic compounds involving reactions such as Acylation, Oxidation, Esterification, Hydrogenation (6 P)

**Reference Books**

1. A text of quantitative inorganic analysis, A. L. Vogel , ELBS London. 1995.
2. Experiments in physical chemistry, D.P. Shoemaker and C.W. Gardad, McGraw Hill, London, 2001.
3. American Public Health Association.

2021BS103	Biology for Engineering	2L:0T:0P	2 credits
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### Course Objectives:

This course enables the students to:

1. Recognize and understand the biomolecules related metabolic pathways and applicable bioenergetics.
2. Relate common biological phenomenon at molecular level.
3. Comprehend the steps involved in common application of microbial and industrial biotechnology
4. Understand the importance of cell culture and its applications
5. Develop an enterprising attitude through discussion of products of biomedical diagnosis and various industrial applications

### Course Outcomes:

After the completion of this course, students will be able to:

1. Demonstrate an understanding of fundamental biochemical principles, such as the function of biomolecules involved in living system.
2. Interpret the applications of molecular biology.
3. Correlate the basic methods involved in common biotechnological application.
4. Apply and effectively communicate scientific reasoning and data involved in common biotechnological applications
5. The students will be able to acquire knowledge to apply engineering solutions in biotechnological industries

### Unit 1: BIOCHEMICAL STRUCTURES AND PATHWAYS

Basics Structure of Biomolecules Amino Acids, Lipids, Carbohydrates, Vitamins, Nucleic acids (DNA, RNA). Basic concept of metabolism and Regulation of metabolic pathways photosynthesis, glycolysis, and the Krebs cycle, electron transport chain; metabolic disorders, aging and senescence; Programmed cell death and apoptosis. (06 L)

### Unit II: BASICS OF GENETIC ENGINEERING

DNA replication; Central Dogma of Genetics; Principles and techniques of recombinant DNA technology: plasmids, bacteriophage vectors; Genomic and cDNA libraries, DNA and protein sequencing, Polymerase Chain Reactions (PCR), DNA fingerprinting, Molecular markers, gene therapy; oncogenes, proto-oncogenes and tumour suppressor genes. Applications in products. (06 L)

### **Unit III: CELL ENGINEERING AND APPLICATIONS**

Eucaryotic Cell structure; Cell culture techniques; Tissue engineering; Animal cloning basic concept; Production of pharmaceuticals by genetically engineered cells- hormones and vaccines; Bioactive compounds, Single cell protein; Production of Vaccines; Regulatory ethics and issues in genetically engineered products. (06 L)

### **Unit IV: MICROBIAL ENGINEERING PRODUCTS**

Synthetic biology- Bioethanol; Biodiesel; Bioreactors; Membrane based bioseparations; Biomolecular electronics; Biosensors; Gut microflora, its sustainability, combinations, prebiotics, probiotics, symbiotic foods; Antibiotics produced from micro-organisms and application in foods like Bacteriocins; Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals). (06 L)

### **Unit V: TRENDS IN BIOENGINEERING**

Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Brain as a CPU system (CNS and Peripheral Nervous System, EEG). Heart as a pump system (ECG monitoring, design of stents, pace makers, defibrillators). Bioprinting techniques and prosthetics; 3D printed foods. (06 L)

### **Reference books**

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P., Molecular Biology of the Cell, 5th Edition, Garland Science Publishing (2008)
2. Byong H. Lee, (2014) Fundamentals of Food Biotechnology, 2nd Edition, WileyBlackwell.A
3. Nelson, D.L. and Cox, M.M., Lehninger Principles of Biochemistry, W.H. Freeman (2008) 5th ed.
4. Primrose, S.B. and Twyman, R.M., Principles of Gene Manipulation and Genomics, Blackwell Publishing (2006).
5. R. Ian Freshney Culture of Animal Cells: A Manual of Basic Technique, 4th Edition” 2000
6. Raj Pethuru and Raman Anupama C., The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press
7. Saltzman WM. Biomedical Engineering Bridging Medicine and Technology 2009 (ISBN-13: 9780521840996
8. Shetty, K., Plaiyath, G., Pometto, A. and Levin, R.E., Functional Foods & Biotechnology, CRC Press (2006)
9. Wilson, K. and Walker, J., Practical Biochemistry, Principles and Techniques, Cambridge University Press (1995) 5th ed.

2021BS104	Mathematics-I	3L:0T:0P	3 credits
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**Course Objectives:**

1. Apply the matrix technique (Linear algebra) to find solutions of system of linear equations arising in many engineering problems.
2. To understand and solve first and higher order differential equations and apply them as a mathematical modeling in electric and mechanical systems.
3. Imparting the knowledge of real time applications of partial differential equations and partial differential equations.

**Course Outcomes:** At the end of the course, students will demonstrate the ability to:

1. Students will be able to solve matrix technique (Linear algebra) to find solutions of system of linear equations arising in many engineering problems.
2. Students will be able to analyse and develop the first and higher order differential equations
3. Students will be able to understand concept of the partial differentiation.
4. Students will be able to understand Concept of Jacobians Maxima and Minima of Function

**Course Contents:**

**Unit I: Linear Algebra: Matrices, Vectors, Determinants, Linear Systems:(9L)**

Matrices, Vectors: Addition and Scalar Multiplication, Matrix Multiplication, Linear Systems of Equations, Gauss Elimination, Linear Independence. Rank of a Matrix, Solutions of Linear Systems: Existence, Uniqueness, Determinants, Cramer's Rule, Inverse of a Matrix. Gauss-Jordan Elimination

**Unit II: Linear Algebra: Matrix Eigen value Problems:(9L)**

Eigen values, Eigen vectors, Applications of Eigen value Problems, Symmetric, Skew-Symmetric, and Orthogonal Matrices

**Unit III: First order Differential Equations: (9L)**

Differential equations of first order and first degree (non-homogeneous), Exact, linear and Reducible to linear form. Application to Mechanical and Electrical circuit. orthogonal trajectories

**Unit IV: Higher order Linear Differential Equations:(9L)**

$n^{\text{th}}$  order differential equations with constant Coefficients, complimentary function, short cut methods to find integral canchy' sandlegendre's forms, Method of variation of parameters

**Unit V: Partial Differentiation:(9L)**

Partial derivatives, Total derivatives, Euler's theorem on Homogeneous functions. Implicit function, change of independent variables. Jacobians, Maxima and Minima of functions.

**Textbooks:**

1. ATextBookof Applied Mathematics, P.N. Wartikar and J.N.Walikar, Vol. I,II, III Pune dyarathi Griha Prakashan
2. Advance Engineering Mathematics, H.K. Dass, S. Chandaand Co. ltd.,
3. HigherEngineering Mathematics, B.V. Ramana, TataMc-Graw HillPublication Co., Ltd.,

**Reference Books:**

1. Higher Engineering Mathematics, John Bird, fifth Edition, Elsevier, Linacre House, Jordan Hill, Oxford, 2006.
2. Kreyszig,Erwin, I.S., Advanced Engineering Mathematics, Wiley, 1999
3. Engineering Mathematics : A Tutorial Approach, Mukul Bhatt and Ravish R. Singh, Tata McGraw Hill Education Private Ltd., New Delhi, 2010

2021ES101	Engineering Graphics	3L:0T:0P	3 credits
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**Course Objectives:**

The objective of learning this subject at undergraduate level is to develop vision, imagination and presentation skill required for drawing and presentation of various engineering component in 2-D and 3-D by using first angle method of projections only except for projections of straight lines.

**Course Outcomes:**

The students will be able to

1. Draw projections of lines, planes, solids, isometric projections and sections of solids including cylinders, cones, prisms and pyramids using AutoCAD
2. Imagine and visualize the geometric details of engineering objects.
3. Translate the geometric information of engineering objects into engineering drawings.
4. Use computer aided drafting in their respective engineering field.

**Unit-I : INTRODUCTION TO ENGINEERING DRAWING** -Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales. (10 Hrs)

**Unit-II: PROJECTIONS OF STRAIGHT LINES** - Line inclined to one plane, line inclined to both the reference planes, and in different quadrants, traces of a line.

**PROJECTIONS OF PLANES** –Planes with surface inclined to both the planes. Planes such as triangles, squares, rectangles, quadrilaterals, pentagon, hexagon, circle, semicircle. (10Hrs)

**Unit-III: PROJECTIONS OF SOLIDS** –Projections of solids such as prism, cylinder, pyramid, cone, sphere, frustum, cube tetrahedron, with axis inclined to one or both the reference planes. (10Hrs)

**Unit-IV: SECTIONS OF SOLIDS** –Projections of regular solids such as prism, cylinder, pyramid, cone, cube, tetrahedron, cut by cutting planes inclined to one plane. Determination of cutting plane angle from the given true shape of the section. (10Hrs)

**Unit-V: ORTHOGRAPHIC PROJECTIONS:** - Obtaining orthographic projections of

different machine parts from the given 3D view, sectional orthographic projections. (10 Hrs)

**Unit-VI: ISOMETRIC PROJECTIONS:** - Introduction to isometric projections and isometric views, isometric and nonisometric lines. Drawing Isometric views of simple machine parts. (10 Hrs)

**Reference Books:**

1. Elementary Engineering Drawing, N D Bhatt, Charotar Publication House
2. A Text Book of engineering Graphics, M L Dhabhade, Association of Technical Authors, Pune
3. Engineering Drawing Mali &Chaudhary, Vrinda Publishers
4. Engineering Drawing, BasantAgrawal, C. M. AgrawalTata McGraw-Hill Education, 2008
5. Engineering Drawing, M. B. Shah, B. C. Rana. Pearson Education India
6. Engineering Drawing, Dhananjay A. Jolhe, Tata McGraw-Hill Education
7. Engineering Drawing B. V. R. Gupta, M. Raja Roy I. K. International Pvt. Ltd

2021ES102	Engineering Graphics (Lab)	0L:0T:4P	2 credits
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**Course Objectives:**

The objective of learning this subject at undergraduate level is to develop vision, imagination and presentation skill required for drawing and presentation of various engineering components in 2-D and 3-D by using first angle method of projections only except for projections of straight lines.

**Course Outcomes:**

1. Draw orthographic projections of lines, planes and solids.
2. Construct isometric scale, isometric projections and views.
3. Draw sections of solids including cylinders, cones, prisms and pyramids.

**List of Practicals (Not Less than 10)**

1. **Sheet No. 1: Projections of Lines:** To solve at least two problems based on line inclined to both the planes and one problem on applications of straight lines, with following objectives,
  - i. Obtaining projections of line inclined to both the planes,
  - ii. Determination of true length and true inclinations of the line,
  - iii. Locating traces of the line, and its use for obtaining true length and inclination of the line.
  - iv. To understand applications of straight lines.
2. **Sheet No. 2: Projections of Planes:** To solve at least three problems on planes inclined to both the reference planes, with following objectives,
  - i. Obtaining projections of planes of different (polygonal, circular, semicircular etc.) shapes, inclined to both the planes.
  - ii. Determination of true shape and inclinations of the plane.
3. **Sheet No. 3: Projections of Solids:** To solve at least three problems based on solids with axis inclined to both the reference planes, with following objective,
  - i. Obtaining projections of different regular geometrical solids, having axis inclined to both the reference planes.

4. **Sheet No. 4: Sections of Solids:** At least two problems to be solved on sections of solids, with following objectives,

- i. Drawing section line view of the cutting plane in correct view,
- ii. Drawing sectional view, and true shape of the section,
- iii. Determining inclination of the cutting plane from the given true shape of the section.

5. **Sheet No. 5: Orthographic and Sectional Orthographic Projections:** At least two problems to be solved on, orthographic projections and sectional orthographic projections, with following objective,

- i. Reading the 3D drawings and converting it in 2D views.

6. **Sheet No. 6: Isometric Views:** Solving at least one problem for isometric view, and one for isometric projections for simple machine parts with following objective,

- i. Reading the 2D drawings and converting it in 3D views.

#### Reference Books

SN	Title	Author	Publication
1	Elementary Engineering Drawing	N D Bhatt	Charotar Publication House
2	A Text Book of engineering Graphics	M L Dhabhade	Association of Technical Authors, Pune
3	Engineering Drawing	Mali &Chaudhary	Vrinda Publishers
4	Engineering Drawing	BasantAgrawal C. M. Agrawal	Tata McGraw-Hill Education, 2008
5	Engineering Drawing	M. B. Shah, B. C. Rana	Pearson Education India
6	Engineering Drawing	Dhananjay A. Jolhe	Tata McGraw-Hill Education
7	Engineering Drawing	B. V. R. Gupta M. Raja Roy	I. K. International Pvt. Ltd

2021ES103	Environmental Science	2L:0T:0P	2 credits
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### Course Objectives

Students acquire knowledge about the environment, ecosystems and biodiversity

### Course Outcomes:

1. Understand the environment, ecosystems and biodiversity
2. Understand the natural resources available in the earth and how it get polluted
3. Understand the influence of social issues and human population on the Environment

### UNIT I: ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY (08 Hrs)

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

### UNIT II: ENVIRONMENTAL POLLUTION (08 Hrs)

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

### UNIT III: NATURAL RESOURCES (06 Hrs)

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – 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 overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

#### **UNIT IV: SOCIAL ISSUES AND THE ENVIRONMENT (06 Hrs)**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization-environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

#### **UNIT V: HUMAN POPULATION AND THE ENVIRONMENT (04 Hrs)**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

#### **TEXT BOOKS:**

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

#### **REFERENCES:**

1. Dharmendra S. Sengar, 'Environmental law', Prentice Hall of India PVT LTD, New Delhi, 2007.
1. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
2. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press,2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014

<b>2021SE101</b>	<b>Laboratory Skills</b>	<b>0L:0T:2P</b>	<b>1 credits</b>
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**Course Objectives:**

The learning objectives of Laboratory Skills are

1. To understand the Good Laboratory Practices of the various laboratories
2. To understand and learn the self-behavioral pattern while working in the laboratories
3. To acclimatize with the working environment of the various laboratories

**Course Outcomes:**

After completion, the students will able to

1. Understand the Good Laboratory Practices of various laboratories
2. Learn the self-behavioral pattern while working in the laboratories
3. Acclimatize with the working environment of the various laboratories

**EXPERIMENTS:**

1. Introduction to Basic Science Laboratories
2. Introduction to Basic Engineering Laboratories
3. Introduction to Pharmaceutical Technology Laboratories
4. Introduction to Food Technology Laboratories
5. To study the Good Laboratory Practice features of the laboratories
6. To study the “Dos and Don’ts” of the laboratories
7. To study the Safety norms of the various laboratories
8. To study the various instruments used in the laboratories
9. To study the various Standard Operating Procedures of the Laboratory instruments
10. To study the various Chemicals used in the Laboratories
11. To study the various Glassware used in the Laboratories
12. To study the various Plastic-ware used in the Laboratories
13. To study the various analytical grade standards& Fine Chemicals used in the Laboratories

## Reference Books:

1. "OECD Principles of Good Laboratory Practice (as revised in 1997)". OECD Environmental Health and Safety Publications. 1. OECD. 1998. Archived from the original on 20 April 2010. Retrieved 15 October 2006.
2. "OECD Principles of Good Laboratory Practice (GLP) and GLP Compliance Monitoring". Organisation for Economic Co-operation and Development. Retrieved April 28, 2024.
3. "Good Laboratory Practice (GLP) Final Rule, 12/22/1978". U.S. Food and Drug Administration. December 22, 2020 [December 22, 1978]. Retrieved April 23, 2024.
4. Baldeshwiler, Anne (29 July 2003). "History of FDA good laboratory practices". *The Quality Assurance Journal*. 7 (3): 157–161. doi:10.1002/qaj.228. eISSN 1099-1786. ISSN 1087-8378 – via Wiley Online Library.
5. Kevin Robinson for BioPharm International, 1 Aug 2003. GLPs and the Importance of Standard Operating Procedures Archived 21 March 2005 at the Wayback Machine
6. Rasmussen, Seth C (2019-12-16). "A Brief History of Early Silica Glass: Impact on Science and Society". *Substantia*: 125 – 138 Pages.
7. Espahangizi, Kijan (2015). "From Topos to Oikos: The Standardization of Glass Containers as Epistemic Boundaries in Modern Laboratory Research (1850–1900)" (PDF). *Science in Context*. **28** (3): 397–25.
8. Jump up to:<sup>a</sup> <sup>b</sup> <sup>c</sup> Jackson, Catherine M. (2015-03-01). "The "Wonderful Properties of Glass": Liebig'sKaliapparatand the Practice of Chemistry in Glass". *Isis*. **106** (1): 43– 69.
9. "Chemical manipulation; being instructions to students in chemistry, on the methods of performing experiments of demonstration or of research, with accuracy and success / By Michael Faraday". Wellcome Collection. Retrieved 2022-03-25.
10. Espahangizi, Kijan (2015-08-10). "From Topos to Oikos: The Standardization of Glass Containers as Epistemic Boundaries in Modern Laboratory Research (1850–1900)". *Science in Context*. **28** (3): 397–425.

<b>2021AE101</b>	<b>Development of Skills-I</b>	<b>0L:0T:4P</b>	<b>2 credits</b>
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**Course Objectives:**

1. To help engineering students in acquiring adequate mastery of communicative English language primarily - listening and speaking skills.
2. To provide language training to the students to enable them to understand and acquire knowledge in technical subjects.
3. To help students develop their personal and interpersonal skills to enable them to make their transition from college to workplace smoother and help them excel in their jobs

**Course Outcome**

1. Develop proper listening skills
2. Articulate and enunciate words and sentences clearly and efficiently
3. Show confidence and clarity in public speaking projects

**List of Practicals (Not Less than 10)**

<b>SN</b>	<b>Section</b>	<b>Content</b>
1	Introduction	Importance of Soft Skills in general, Communication Skills in particular.
2	Communication Process	Basic Concepts, Kinds, Routes Forms, Factors, Barriers. Activity in understanding the barriers in communication.
3	Oral communication	Introduction to various types: Formal, Informal, Face to Face, Telephonic. Activity: Self Introduction or Introduction in pairs.
4	Listening Skills	Listening process, Hearing and Listening, Types of listening - superficial, appreciative, focused, evaluative, attentive, empathetic, Barriers in listening, Effective listening strategies. Activities: Listening in conversational interaction, listening to structured talks, Team listening.
5	Speaking Skills	Phonetics and problems in learning and using pronunciation Vowel sounds, Consonant Sounds, Word accent, Sentence Intonation

- |   |   |   |
|---|---|---|
| 6 | Conversation Skills(Dialogue)           | Conversation skills in different situations (Expressing different language functions - orders, requests, advice, suggestions, questions, Opinions (agreement / disagreement), defining, describing<br>Activities: Skits with Social messages and Role Plays |
| 7 | Public Speaking and Presentation skills | Planning, Preparation, Organization, Delivery in Seminars<br>Compeering/Anchoring<br>Activities: Speeches, JAM Sessions   |

### Reference Books

Sr. No.	Title	Author	Publication
1	The Essence of Effective Communication	Adrian Budday, Ron Ludlow and Fergus' Panton	Prentice Hall of India-Private Ltd.
2	Communicating in Style	Yateendra Joshi	The energy Resource Institute
3	Effective Technical Communication	Anne Eisenberge	McGraw Hill International Editors
4	Professional Communication Skills	A. K. Jain, Pravin, S. R. Bhatia, A. M. Sheikh	S. Chand & Company Ltd.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above

<b>2021CC101</b>	<b>Sports &amp; Fitness</b>	<b>0L:0T:4P</b>	<b>2 credits</b>
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**Course Objectives:**

- To impart the students with basic concepts of Physical Education, Sports and Yoga for health and wellness.
- To familiarize the students with health-related Exercise, Sports and Yoga for Overall growth & development
- To create a foundation for the professionals in Physical Education, Sports and Yoga.
- To impart the basic knowledge and skills to teach Physical Education, Sports & Yoga activities.

**Course Outcome:**

- Students will be able to understand the basic principles and practices of Physical Education, Sports and Yoga.
- Students will be able to instruct the Physical Activities, Sports and Yoga practices for Healthy Living.
- To develop professionalism among students to conduct, organize & officiate Physical Education, Sports and Yoga events at schools and community level.

**Unit- I Introduction (15 Hrs.)**

1. Meaning and definition of Physical Education, Sports and Yoga.
2. Aims, Objectives and Importance of Physical Education, Sports and Yoga.
3. History of Physical Education, Sports and Yoga.
4. Modern trends of Physical Education, Sports and Yoga.
5. Brief concept of Education in relation to Physical Education, Sports and Yoga.

**Unit- II Yoga & Fitness Training(15 Hrs.)**

1. Importance of Yoga & Fitness
2. Fundamentals Principles of Yoga & Fitness Training
3. Components of Fitness and Fitness Equipment's
4. Types of Yoga Practices - Asanas, Pranayama and Meditation
5. Introduction to Balanced Diet for Fitness

**Unit- III Introduction to Athletics and Officiating of Sports and Games (15 Hrs.)**

1. Characteristics and Measurement of Standard Track
2. Duties and Principles of officiating
3. Qualities and Qualification of Technical officials for Athletics, Sports and Games
4. Officiating of Athletics
5. Officiating of Sports and Games

**Unit- IV Career Opportunities in Physical Education, Sports and Yoga (15 Hrs.)**

1. Physical Education, Sports and Yoga professionals at various levels of educational institutions.
2. Sports Trainers, Yoga Instructors, Coach, Managers, Researcher, Event Organizers, Technical Officials, Entrepreneurs and others
3. Physical Education, Sports and Yoga Trainer for Police and Paramilitary forces at State and Central organizations and others
4. Health Clubs and Fitness Centers, Aerobics, Dance & Recreation Clubs in Corporate Sectors and others.
5. Sports Journalists, Commentators, Photo and Video Analyst, Sports Marketing and Equipment/Props manufactures.

**Reference Books:**

1. Bucher, C. A. (n.d.) Foundation of physical education. St. Louis: The C.V. Mosby Co.
2. Deshpande, S. H. (2014). Physical Education in Ancient India. Amravati: Degree college of Physical education.
3. Mohan, V. M. (1969). Principles of physical education. Delhi: Metropolitan Book Dep.
4. Nixon, E. E. & Cozen, F.W. (1969). An introduction to physical education. Philadelphia: W.B. Saunders Co.
5. William, J. F. (1964). The principles of physical education. Philadelphia: W.B. Saunders Co.
6. Coalter, F. (2013) Sport for Development: What game are we playing?. Routledge.
7. Singh Hardayal (1991), Science of Sports Training, DVS Publication, New Delhi
8. Sandeep Jagtap, Health and Fitness, Prashant Publication, Jalgaon (MS)

7. Muller, J. P.(2000). Health, Exercise and Fitness. Delhi : Sports.
8. Russell, R.P.(1994). Health and Fitness Through Physical Education. USA : Human Kinetics.
9. Uppal, A.K. (1992). Physical Fitness. New Delhi : Friends Publication.
10. Nagendra, H. R. & Nagarathna, R. (2002). Samagra Yoga Chikitse. Bengaluru: Swami Vivekananda Yoga Prakasana.
11. Kumar, Ajith. (1984) Yoga Pravesha. Bengaluru: Rashthrothanna Prakashana.
12. D.M Jyoti, Yoga and Physical Activities (2015) lulu.com3101, Hills borough, NC27609, United States
13. D.M Jyoti, Athletics (2015) lulu.com3101, Hills borough, NC27609, United States
14. Gharote, M. L. & Ganguly, H. (1988). Teaching methods for yogic practices. Lonawala: Kaivalyadhama.
15. Pinto John and Roshan Kumar Shetty (2021) Introduction to Physical Education, Louis Publications, Mangalore
16. Shekar, K. C. (2003). Yoga for health. Delhi: Khel Sahitya Kendra
17. Amit Arjun Budhe, (2015) Career aspects and Management in Physical Education, Sports Publication, New Delhi
18. IAAF Manual

2021BS105	Chemistry-II	2L:0T:0P	2 credits
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**Course Objective:**

**The learning objectives of the course are**

1. To know the mechanism of rearrangement reactions
2. To know the applications of stereochemistry
3. To know the different heterocyclic compounds and their synthesis and applications for synthesis of different drugs

**Course Outcomes:**

After completion of the course, the students will be able to

1. Get an understanding of theoretical principles, reactions and mechanism of rearrangement reaction.
2. Know the concepts of structure and function of organic reaction and their Stereochemistry.
3. Know the importance of organic synthesis of heterocyclic compounds

**Unit 1: Stereochemistry (6 L)**

Stereochemistry of 1,2 1,3 and 1,4 di substituted cyclohexane.

Chair confirmation of cis-trans decaline and tetracyclic steroidal nucleus.

**Unit 2: Polycyclic aromatic hydrocarbons (6 L)**

IUPAC Nomenclature, synthesis, reactions and stereochemistry of polycyclic compounds

Naphthalene, anthracene and phenanthrene, and Bridged ring compounds.

**Unit 3: Rearrangement reactions (6 L)**

Stereochemistry, reaction mechanism, and rearrangement in biological system of following rearrangement reactions

Pinacol-pinacolone rearrangement

Beckmann

Baeyer –Villiger rearrangement, Curtius, Wolf and Lossen rearrangement.

Willgerodt rearrangement, Schmidt, Wittig, Hoffman.

**Unit 4: Heterocyclic chemistry (5 L)**

IUPAC Nomenclature, synthesis, Stereochemistry and uses of following Heterocyclic compound.

2 and 3 fused rings containing mono, di and multiple hetro atoms.

Synthesis of 5- and 6-member ring containing mono and di hetro atoms (O, S and N).

Synthesis of Quinoline, Isoquinoline, etc.

**Unit 5: Oxidation reduction reaction (5 L)**

Kmno<sub>4</sub>, K<sub>2</sub>cr<sub>2</sub>o<sub>7</sub>, H<sub>2</sub>o<sub>2</sub>, Mno<sub>2</sub>, Pd, LiALH<sub>4</sub>, NaBH<sub>4</sub>, NH<sub>2</sub> NH<sub>2</sub>

and their use in biological system.

**Unit 6: Synthesis of Organo metallic compound and their uses in Biological system (2 L)**

**Text Books**

1. R.T. Morrison and R.N. Boyd "Organic Chemistry" VI Edition Prentice Hall Inc (1996) USA.
2. K.S. Tiwari, N.K. Vishnoi and S.N. Malhotra "A text book of Organic Chemistry" Second Edition, Vikas Publishing House Pvt. Ltd. (1998) New Delhi.
3. P.W. Atkins, Elements of Physical Chemistry, 4th Edition, Oxford University Press
4. C.N. Banwell and E. M. Mac Cash, Fundamentals of Molecular Spectroscopy, 5th Edition, 29
5. P.K. Kar, S. Dash and B. Mishra, B.Tech. Chemistry Vol.I, Kalyani Publications

**Reference books**

1. Chemistry in Engineering and Technology, Vol.2, TMH Publishing Co Ltd., New Delhi, 1994.
2. I L Finar "Organic Chemistry" ELBS (1994).

2021BS106	Chemistry-II (Lab)	0L:0T:2P	1 credits
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**Course Objective:**

**The learning objectives of the course are**

1. To know the separation methods
2. To know the identification of functional groups
3. To understand the synthesis of derivatives of different organic compounds

**Course Outcomes:**

After completion of the course, the students will be able to

1. Separate the binary mixtures
2. Identify the different functional groups
3. Understand the derivative synthesis and their melting and boiling points

**EXPERIMENTS: (30 Hrs. P)**

Organic Qualitative Analysis of binary mixtures: (any one compound) (At least Eight Experiment)

1. Separation
2. Element identification
3. Functional group identification,
4. Melting and boiling point
5. Derivatives preparation

**Reference Books**

1. A text of quantitative inorganic analysis, A. L. Vogel , ELBS London. 1995.
2. Experiments in physical chemistry, D.P. Shoemaker and C.W. Gardad, McGraw Hill, London, 2001.
3. American Public Health Association.

2021BS107	Physics	1L:0T:0P	1 credits
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**Course Objectives:**

The learning objectives of the Physics are

1. To understand the properties of the laser and to learn its construction, working and applications
2. To understand the fiber optic technology
3. To understand the concept of nuclear physics

**Course Outcomes:**

After completion of the physics course, students will be able to

1. Understand the properties of the laser and to learn its construction, working and applications
2. Understand the fiber optic technology
3. Understand the concept of nuclear physics

**Unit 1: Laser**

Properties of laser, absorption, spontaneous & stimulated emission, meta stable state, population inversion, active medium, pumping methods – Optical pumping, Electric discharge, Chemical pumping and Direct conversion, resonant cavity, ruby laser, He-Ne laser - construction working and applications. (5 L)

**Unit 2: Fiber Optics Technology**

Propagation of light through optical fiber, acceptance angle and cone, numerical aperture, types of optical fiber communication system, applications (3 L)

**Unit 3: Nuclear Physics**

Radioactivity, Laws of radioactivity, Half-life, Rate of decay -disintegration constant, Alpha decay, Beta decay, Gamma decay, Nuclear energy, Fission, Controlled fission reaction, Nuclear Reactor, Nuclear Fusion – energy generation in stars (7 L)

**Text books:**

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

**References:**

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca,

<b>2021BS108</b>	<b>Physics (Lab)</b>	<b>0L:0T:2P</b>	<b>1 credits</b>
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**Course Objectives:**

The learning objectives of the Physics are

1. To understand the properties of the laser and to learn its construction, working and applications
2. To understand the fiber optic technology
3. To understand the concept of nuclear physics

**Course Outcomes:**

After completion of the physics course, students will be able to

1. Understand the properties of the laser and to learn its construction, working and applications
2. Understand the fiber optic technology
3. Understand the concept of nuclear physics

**Experiments**

1. To find the cross-sectional area of a wire using a screw gauge.
2. To find the thickness and volume of a glass piece using a screw gauge.
3. To find volume of a solid cylinder using a Vernier Calipers.
4. To find volume of a hollow cylinder using a Vernier Calipers
5. To determine the radius of curvature of convex surface using a Spherometer.
6. To determine the radius of curvature of concave surface using a Spherometer.
7. To find the time period of a simple pendulum and determine acceleration due to gravity
8. To determine the angle of Prism.
9. To determine the angle of Minimum Deviation by I ~ D curve method.
10. To trace lines of force due to a bar magnet with North pole pointing North and locate the neutral points.
11. To trace lines of force due to a bar magnet with North pole pointing South and locate the neutral points.
12. To verify Ohm's Law by Ammeter – Voltmeter method.

**Reference Books:**

1. Laboratory manual on Engineering Physics of 1st semester, developed by DTET, Odisha and S.C.T.E.V.T, Odisha
2. ISC Practical Physics (Class XI and XII), K. N. Sharma and M. N. Chanana, Kalyani Publisher
3. Practical Physics (Class XI and XII), A. Sharma, Modern's ABC

2021BS109	Mathematics-II	3L:0T:0P	3 credits
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**Course Objectives:**

1. To provide in depth knowledge of Laplace and Inverse Laplace Transform.
2. To find the solution of Partial differential equations.
3. Imparting the knowledge of Vector Calculus.

**Course Outcomes:** At the end of the course, students will demonstrate the ability to:

1. Students will be able to depth knowledge of Laplace and Inverse Laplace transform.
2. Students will be able to analyse and develop Partial differential equations
3. Students will be able to understand concept of the, Directional Derivative, Gradient, Divergence and Curl
4. Students will be able to Apply Green theorem for evaluating Vector Integration

**Course Contents:**

**Unit I Laplace Transform:(9L)**

Definition, condition for existence; transforms of elementary functions, Properties of Laplace transforms: Linearity property, first shifting property, second shifting property, change of scale property, transforms of function multiplied by  $t^n$  transforms of function divided by  $t$ , transforms of integral of function, transforms of derivative; Evaluation of integral by using Laplace transforms

**Unit II Inverse Laplace Transform:(9L)**

Inverse Laplace transform and its application Inverse Laplace transforms by using some elementary function; finding inverse transforms by partial fractions method, Convolution theorem. Applications to solve linear differential equations with constant coefficients (Initial value problems), Simultaneous Linear differential equations

**Unit III Partial Differential Equations:(9L)**

Formation of partial differential equation by eliminating arbitrary constant and function, linear equations of first order (Lagrange's linear equation), Method of separation of variables. Application to one dimensional heat flow, two-dimensional heat flow

**Unit IV Vector Differential Calculus. Grad, Div, Curl:(9L)**

Vectors in 2-Space and 3-Space, Inner Product (Dot Product), Vector Product (Cross Product),  
Vector and Scalar Functions and Fields, Derivatives, Curves, Arc Length, Curvature,  
Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field.

**Unit V Integral Calculus. Integral Theorems: (9L)**

Line Integrals, Path Independence of Line Integrals, Green's Theorem in the Plane,  
Surfaces for Surface Integrals, Surface Integrals

**Text Books:**

1. A Text Book of Applied Mathematics, P.N. Wartikar and J.N. Walikar, Vol. I, II, III Pune  
dyarathi Griha Prakashan
2. Advance Engineering Mathematics, H.K. Dass, S. Chanda and Co. Ltd.,
3. Higher Engineering Mathematics, B.V. Ramana, Tata Mc-Graw Hill Publication  
Co., Ltd.,

**References Books:**

1. Higher Engineering Mathematics, John Bird, fifth Edition, Elsevier, Linacre House,  
Jordan Hill, Oxford, 2006.
2. Kreyszig, Erwin, I.S., Advanced Engineering Mathematics, Wiley, 1999
3. Engineering Mathematics A tutorial Approach, Mukul Bhatt and Ravish R. Singh, Tata  
McGraw Hill Education Private Ltd., New Delhi, 2010

<b>2021ES104</b>	<b>Engineering Applications of Computer</b>	<b>1L:0T:0P</b>	<b>1 credits</b>
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### **Course Objectives:**

Prime objective is to give a basic introduction to programming and problem solving with Python.

1. To understand problem solving, its aspects, programming and to understand various types of tools to solve problem.
2. To learn problem solving using computers.
3. To learn basics of Object Programming using Python.
4. To learn basics of Python programming.
5. To acquire knowledge of different data types, I/O statements, decision making, functions.

### **Course Outcomes:**

1. Inculcate and apply various skills in problem solving.
2. Choose appropriate design and write code for problem solving.
3. Exhibit programming skills.
4. Demonstrate significant experience with Python for Program development.
5. Apply Knowledge of Python for daily Data Analysis Applications.

### **UNIT I: Computer Fundamentals (03 L)**

Definition of computer, its types, block diagram of computer, Hardware and software, types of Input and output devices, memory, processor, applications of computers Definition of algorithm, flow chart, characteristics of a good algorithm, symbols used for drawing a Flow chart

### **UNIT II: An Introduction to Python (03 L)**

Installation of Python , Features of Python, Writing and running Python codes, data types, variables, literals, constants ,identifiers, input operations comments reserved words, indentation, operators and expressions in Python, Arrays in Python.

### **UNIT III Decision Control Statements (03 L)**

Selection/ conditional branching statements: if,if-else,nested if , if-elif-else statements Basic Loops: structures/Iterative statements while loop, for loop, nested loop, switch ,break, continue ,pass, else statements used with loops. Other data types: Tuple, lists, dictionary

#### **UNIT IV: Functions and Modules:(03 L)**

Definition of Function, need, call, variable scope and lifetime, return statement Introduction to modules, packages and standard library modules. String and its operations.

#### **UNIT V: Data Analysis(03 L)**

Definition, how to handle, linear and non-linear equations, curve fitting, regression

#### **Reference Books**

1. Business Applications of Computers, Oka, M. M. 10th ed Everest
2. Computer Applications with C & C++: With Programs & Numerical Problems, Abhyankar, A. K. C- Aditi
3. Computer Fundamentals: Concepts, Systems & Applications, Sinha, P. K. BPB
4. Computer Networks & Internets: With Internet Applications Comer, Douglas 4th ed Pearson

2021ES105	Engineering Applications of Computer (Lab)	0L:0T:2P	1 credits
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**Course Objectives:**

1. To enable the student to learn and use the major components of a computer system
2. To make the students write programs and solve problems
3. To learn to use office automation tools

**Course outcomes**

1. At the end of the lab session student will be able to use MS office and generate data, solve simple problems with C-Programming Language
2. Students will able to generate programs for engineering applications

**Practical List:**

1. Write a Program in Python to demonstrate different number data types.
2. Write a program in Python to demonstrate different arithmetic operations on numbers in Python.
3. Write a program to demonstrate different operations on string.
4. Write a program in Python to create, append and remove a list.
5. Write a program to find largest of three numbers.
6. Write a program to convert temperature from Celsius to Fahrenheit.
7. Write a program to find weather the given number is :
8. Prime or not
9. Perfect or not
10. Even or notUsing switch statement.
11. Write a program in Python to find the factorial of a given number using while loop.
12. Write a program in Python for printing Fibonacci series using For loop1 1 2 3 5 8
13. Write a program in Python for finding LCM and GCD of two numbers.
14. Find the Largest number from a given list using Python.
15. Write a program using arrays to arrange the numbers in ascending or descending order.
16. Write a Python script to print the current date/time in following format
17. Write a program to demonstrate working withtuples in Python
18. Write a program in Python to demonstrate a simple linear regression.

**Text Books:**

1. Introduction to Computing And Solving Using Python (Mc Graw Hill India -E. Balgurusamy)
2. Python Programming using Problem Solving Approach ( Oxford -Reema Thareja)

**Reference Books:**

1. Drive into Python, Mike
2. Programming Python- Mark Lutz 4'th edition.

**E-resources:**

1. <https://nptel.ac.in/courses/106106145/>
2. <https://www.python.org/tutorial>

2021ES106	<b>Basic Mechanical Engineering</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
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**Course Objectives:**

Introduction of Mechanical Engineering to the students from all branches of engineering

1. To understand the scope of the different fields of Mechanical Engineering such as Power, Design and Production.
2. Learn the fundamental concepts of energy, its sources and conversion
3. Comprehend the concepts of thermodynamics first, second law of thermodynamics
4. To understand the concepts of boilers, turbines, pumps, IC Engines and refrigeration

**Course Outcomes:**

1. To understand the first, second law of thermodynamics, the concept of entropy and its application to a variety of engineering systems
2. To give understanding of the various devices, thermal machines and manufacturing processes used in day-to-day life.

**Unit-I:**

Sources of Energy:-Introduction and Classification of Energy sources Conventional energy sources like solid, liquid and gasses and Nuclear fuels, Non conventional energy sources Solar energy, Wind energy Hydraulic energy, Biomass and Geothermal energy, Comparison of conventional and nonconventional energy sources. Environmental issues like global warming and ozone depletion (08 Hrs)

**Unit-II:**

Work and Heat : Thermodynamic definition of work, types of work, quasi static process, Pdv work for different processes, Definition of heat, specific heat, modes of heat transfer, laws governing the modes of heat transfer, comparison between heat & work (numerical on types of works). First Law of thermodynamics :Statement of First law of thermodynamics, verification of first law by Jules experiment, PMM1, First law for cyclic and non-cyclic (Non flow) processes, Concept of internal energy , enthalpy. Application of first law in various processes.(Numerical on single process only. (08 Hrs)

**Unit-III:**

Thermal Machines: Boiler: Classification, construction and working of boiler (Lancashire, Benson only), boiler mountings and accessories location and applications only. Turbines:

Classification, working principle of steam turbine-impulse and reaction type, Gas turbine- open cycle and closed cycle. Internal Combustion Engines: Classification, Construction parts, Working 4/2-stroke Petrol and diesel engines. P-V diagram. Refrigeration and Air conditioning, Definitions Refrigeration, Refrigerating effect, COP, Unit of Refrigeration TOR. Principle and working of vapour compression refrigeration. Principle and working of air conditioner and air cooler. (07 Hrs)

**Unit-IV:**

Introduction to Engineering Materials: Introduction, Classification, Properties, Selection and application of materials. Basic heat treatment Processes: Annealing, Normalizing and Hardening. Metal forming and Metal Joining Processes : Hot working and cold working process, its advantage and disadvantages, Brief explanation of operations rolling, forging, extrusion and Wire drawing and its type. Introduction and classification of welding, brief description of Arc Welding and Oxy-Acetylene welding and its application. Soldering and Brazing processes. (07 Hrs)

**Unit-V:**

Machine Tools: Introduction and classification of machine tools, working principle block diagram and operations carried on Lathe machine, Drilling machine, Milling and shaping machines. Specification of above machines. (06 Hrs)

**Unit-VI:**

Power Transmission Elements: Belt: Types of belt and its material, Belt Drives-types and application, velocity ratio, creep and slip in belt. Pulleys: Idler pulley stepped pulley, fast and loose pulley. Gears: Definition, Terminology, types and uses. Gear drives. Bearings-types and application Keys and Coupling: Types of keys, coupling types, rigid flange and bushed pin flexible coupling. Clutch: Types, description of single plate clutch. (09 Hrs)

**Text Books:**

1. Fundamentals of classical by P. K. Nag, Tata McGraw hill
2. Thermal Engineering by R. K. Rajput, Laxmi publication
3. Thermal Engineering by P. L. Ballany, Khanna publication
4. Thermodynamics by C. P. Arora, Tata McGraw hill
5. Engineering thermodynamics, Edward Arnold, John Wiley
6. Workshop technology, Hajara Chowdhary, Media
7. Manufacturing science, Amithabh Ghosh, East west press
8. Manufacturing technology, P. N. Rao, Tata McGraw Hill

2021ES107	<b>Basic Mechanical Engineering (Lab)</b>	<b>0L:0T:2P</b>	<b>1 credits</b>
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**Course Objectives:**

1. Introduction of Mechanical Engineering to the students from all branches of engineering
2. To understand the scope of the different fields of Mechanical Engineering such as Power, Design and Production.
3. To give understanding of the various devices, machines and processes used in day to day life.

**Course Outcomes:**

The students will be able to

1. Identify and comprehend the different sources of energy, their conversion processes, working principles of thermal machines viz., IC Engines, Refrigeration and Air Conditioning, Pumps, Turbines
2. Solve engineering problems involving fundamental concepts of thermodynamics
3. Recognise various metal joining processes and power transmission elements.
4. Understand the properties of common engineering materials and their applications in engineering Industry.
5. Understand the working of conventional machine tools, machining processes ,tools and accessories along with advanced manufacturing systems like CNC and Robotics

**List of Practicals (Not Less than 10)**

**Term work shall consist of a record book on laboratory experiments studies on the following:**

1. Study and demonstration Low Pressure Boiler (any one)
2. Study and demonstration High Pressure Boiler (any one)
3. Study and demonstration Steam Turbine
4. Study and demonstration Refrigerator
5. Study and demonstration Air Conditioner
6. Study and demonstration Air Cooler.
7. Study and demonstration Lathe Machine
8. Study and demonstration Milling machine
9. Study and demonstration of Gears
10. Assignment on topic 1,2,3,4

**Text Books:**

1. Fundamentals of classical by P. K. Nag, Tata McGraw hill
2. Thermal Engineering by R. K. Rajput, Laxmi publication
3. Thermal Engineering by P. L. Ballany, Khanna publication
4. Thermodynamics by C. P. Arora, Tata McGraw hill

<b>2021PC101</b>	<b>Dosage Form Technology</b>	<b>2L:0T:0P</b>	<b>2 credits</b>
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**Course Objectives:**

The learning objectives of the Dosage Form Technology course are

1. To Know the history of profession of pharmacy
2. To understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
3. To understand the professional way of handling the prescription
4. To understand the preparation of various conventional dosage forms

**Course Outcomes:**

After completion of the Dosage Form Technology course, students will be able to

1. Know the history of profession of pharmacy
2. Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
3. Understand the professional way of handling the prescription
4. Understand the preparation of various conventional dosage forms

**Unit 1: History of Pharmacy Profession, Dosage Forms, Prescriptions & Posology**

- Historical background and development of profession of pharmacy: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.
- Dosage forms: Introduction to dosage forms, classification and definitions
- Prescription: Definition, Parts of prescription, handling of Prescription and Errors in prescription.
- Posology: Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area. (6 L)

**Unit 2: Pharmaceutical Calculations, Powders & Liquid Dosage Forms**

- Pharmaceutical calculations: Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.

- Powders: Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.
- Liquid dosage forms: Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques. (6 L)

### **Unit 3: Monophasic & Biphasic Liquids**

- Monophasic liquids: Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.
- Biphasic liquids:
  - Suspensions: Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.
  - Emulsions: Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome. (6 L)

### **Unit 4: Suppositories**

- Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.
- Pharmaceutical incompatibilities: Definition, classification, physical, chemical and therapeutic incompatibilities with examples. (4 L)

### **Unit 5: Semisolid dosage forms**

- Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms. (4 L)

### **Unit 6: Parenteral Products and Ophthalmic Preparations**

- Parenteral Products: a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity
- Production procedure, production facilities and controls, aseptic processing
- Formulation of injections, sterile powders, large volume parenterals and lyophilized products.
- Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

- Ophthalmic Preparations: Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations (6 L)

**Recommended Books: (Latest Editions)**

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.
3. M.E. Aulton, Pharmaceutics, The Science & Dosage Form Design, Churchill Livingstone, Edinburgh.
4. Indian pharmacopoeia.
5. British pharmacopoeia.
6. Lachmann. Theory and Practice of Industrial Pharmacy, Lea & Febiger Publisher, The University of Michigan.
7. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi.
8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.
10. Isaac GhebreSellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York.
11. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York.
12. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

<b>2021SE102</b>	<b>Professional Lab Practice</b>	<b>1L:0T:0P</b>	<b>1credits</b>
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**Course Objectives:**

The learning objectives are

1. Students able to understand different tool & equipment for work shop practice.
2. Students acquire skills for the preparation of different Carpentry/fitting/welding models.
3. Students able to understand the safety precaution in the workshop
4. Student acquires skills of Application orientated tasks.

**Course Outcomes:**

After completion, the students will able to

1. Utilise the conception of fitting shop and make typical jobs.
2. Utilise the conception of carpentry shop and make typical jobs.
3. Develop the conception of machining, make use of Lathe, Milling and Shaping machine and construct typical jobs.
4. Make use the conception of joining process and join two MS plate using arc welding and gas welding process.
5. Understand report of procedures followed for a given task in fitting, carpentry, foundry, sheet metals, welding and machine shops.
6. Apply safety consciousness and show team work.

**Unit-I: (03 hr)**

Introduction and demonstration: Introduction to various shops/ sections and workshop layouts, safety norms to be followed in a workshop should be conveyed to students.

**Unit-II (03 hr)**

Carpentry shop: Introduction of tools and operations, types of woods & their applications, types of carpentry hardware and their uses, carpentry joints, carpentry operations such as marking, sawing, planning, chiseling, grooving, boring, joining, types of woods and carpentry hardware.

**Unit-III (03 hr)**

Fitting shop: Introduction of tools and operations, types of marking tools and their uses, types of fitting cutting tool and their uses, fitting operations such as chipping, filing, scraping, grinding, sawing, marking, drilling, tapping.

**Unit-IV (03 hr)**

Metal joining shop: Introduction of tools, types of welding joint, arc welding, gas welding and gas cutting.

**Unit-V (03 hr)**

Machine shop: Introduction of machine tools and operations, demonstrations of basic machine tools like lathe, shaper, drilling, milling machine and CNC with basic operations and uses.

**Text Books:**

1. Choudhury Hajra S.K., Choudhury Hajra A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology Vol. I & II", Media promoters and publishers private limited, Mumbai, 2008 and 2010.
2. Raghuvanshi B.S., "Workshop Technology Vol. I & II", Dhanpath Rai & Sons, 2017.
3. Bawa H S., "Workshop Practices", Tata McGraw-Hill, 2009

<b>2021SE103</b>	<b>Professional Lab Practice (Lab)</b>	<b>0L:0T:2P</b>	<b>1credits</b>
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**Course Objectives:**

The learning objectives are

1. Students able to understand different tool & equipment for work shop practice.
2. Students acquire skills for the preparation of different Carpentry/fitting/welding models.
3. Students able to understand the safety precaution in the workshop
4. Student acquires skills of Application orientated tasks.

**Course Outcomes:**

After completion, the students will able to

1. Utilise the conception of fitting shop and make typical jobs.
2. Utilise the conception of carpentry shop and make typical jobs.
3. Develop the conception of machining, make use of Lathe, Milling and Shaping machine and construct typical jobs.
4. Make use the conception of joining process and join two MS plate using arc welding and gas welding process.
5. Understand report of procedures followed for a given task in fitting, carpentry, foundry, sheet metals, welding and machine shops.
6. Apply safety consciousness and show team work.

**List of workshop practices (Practicals)**

The suitable nos. of practical on the following titles should be conducted

- a. Hands on practice and job making in carpentry.
- b. Hands on practice and job making in fitting.
- c. Hands on practice and job making in welding.
- d. Demonstrate the operations of machine shop.

**Text Books:**

1. Choudhury Hajra S.K., Choudhury Hajra A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology Vol. I & II”, Media promoters and publishers private limited, Mumbai, 2008 and 2010.
2. Raghuvanshi B.S., “Workshop Technology Vol. I & II”, Dhanpath Rai & Sons, 2017.
3. Bawa H S., “Workshop Practices”, Tata McGraw-Hill, 2009

2021AE102	Indian Knowledge System: Indian Health, Wellness & Psychology (Including Ayurveda)	2L:0T:0P	2 credits
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**Course Objectives:**

1. Understanding the fundamental principles of Indian health systems such as Ayurveda and yoga which are useful in maintaining the health of a healthy person
2. Practical implementation of health principles to correct the intake of our food, air, water and sunlight to achieve perfect health.
3. Understanding traditional way of cleansing the body regularly, strengthening body with Yogic exercises, maintaining the internal balance to prevent diseases.

**Course Outcomes:**

1. Describe what is Psychology and examine how it is an integral part of any other subject related to sciences, arts and humanities.
2. Explain the scope of Psychology and interpret its diversity in terms of theoretical and applied branches
3. Describe the scientific methods used in Psychology for studying the behaviour, experiences and mental processes
4. Outline meaning and scope of Health Psychology, relate Psychology and health, and summarize biopsychosocial perspective to health
5. Summarize the Indian perspective to holistic health

**Unit I: Understanding human body (06 Hrs)**

Introduction to Ayurveda, the Knowledge of Life, Health and treatment aspects in Ayurveda, Influence of Pancha mahabhuta on Internal environment of Human being, Understanding composition of Human body through the concept of Dosha Dhatu Mala, Understanding Prakruthi, the Mind – Body Constitution.

**Unit II: Understanding the communication between body & Mind (06 Hrs)**

Establishing communication between body and mind by understanding the language of body. Understanding the concept of Agni, Koshta, Sara and Ojas and their relevance in enhancing our immunity to protect from various infections. Looking at the world through the lenses of Dravya, Guna and Karma Applying the principle of Samanya and Vishesha in every aspect of life to achieve perfect health.

**UnitIII: Introduction to Health Regimen (06 Hrs)**

Understanding Swastha vritta, the healthy regimen to maintain state of well being Dina charya, the Daily regimen including Daily detoxification, exercise, Intake of Food, Water, Air and Sunlight, work and ergonomics, Rest and sleep hygiene. Ritu charya, the seasonal regimen, Sadvritta and the concept of social wellbeing, understanding trividha upastambhas, three pillars to health, Concept of Shadrasa in choosing appropriate nourishment to the body and mind.

**UnitIV: Introduction to Yoga (06 Hrs)**

Definition, Meaning and objectives of Yoga, Relevance of yoga in modern age. Brief Introduction of Hatha yoga, Raja yoga, Karma yoga, Gyana Yoga, Bhakti yoga Understanding eight steps of Ashtanga yoga, Understanding Shatkriyas , the six cleansing procedures of Yoga

**UnitV: Introduction to Indian (06 Hrs)**

Concept of Manas in Ayurveda and understanding Mind Body harmony, Triguna based Psychology in Ayurveda and Yoga, Influence of Tri dosha on Mind, Mind body intellect and consciousness complex, Understanding Consciousness and solution to issues within Human Mind.

**Reference Books:**

1. The Charaka Samhita
2. The Susruta Samhita
3. Teh Ashtanga Hridaya
4. Dr Deepak Chopra, Perfect Health--Revised and Updated: The Complete Mind Body Guide, Harmony publication, 2001
5. Vasant lad, Ayurveda, the Science of Self-healing: A Practical Guide: Science of Selfhealing, lotus press, 1984
6. The Hatha yoga pradipika
7. The Patanjali yoga sutras
8. The Gherandasamhita
9. BKS Iyengar, Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority, thronson publication, 2006
10. Swamy Satyananda Saraswati, Asana, Pranayama, Mudra and Bandha, Bihar School of Yoga, 2002

<b>2021CC102</b>	<b>Yoga &amp; Meditation</b>	<b>0L:0T:4P</b>	<b>2 credits</b>
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**Course objectives:**

1. To enable the student to have good health.
2. To practice mental hygiene.
3. To possess emotional stability.
4. To integrate moral values.
5. To attain higher level of consciousness

**Course Outcomes:**

Students will be able to achieve & demonstrate the following COs on completion of course

1. Practice basic Yoga and Pranayama in daily life to maintain physical and mental fitness.
2. Practice meditation regularly for improving concentration and better handling of stress and anxiety.
3. Follow healthy diet and hygienic practices for maintaining good health.

**List of Practical Titles**

1. Perform warming up exercises to prepare the body from head to toe for Yoga.
2. Perform all the postures of Surya Namaskar one by one in a very slow pace, after warm up.
3. Perform multiple Surya Namaskar (Starting with three and gradually increasing it to twelve) in one go.  
Experiment 2 to 4 must be followed by shavasana for self-relaxation.
4. Supine position asanas: Perform Sarvangasana, Kandharasana (setubandhasana), Naukasana, Shavasana.
5. Prone position asanas: Perform Makarasan, Shalabhasana, Dhanurasana
6. Sitting position asanas: Perform Paschimottasana, Baddhakonasana, Gomukhasana, Ardhamatsendrasana
7. Standing position asanas: Perform Veera-Bhadrasana, Tadasana, Vrukshasana, Trikonasana.  
Follow up shavasana for self-relaxation
8. Simple breathing techniques: Perform Clavicle breathing, Thoracic breathing, Abdominal breathing
9. Practice Kapalbhathi, Nadi Shodhan, Anulom Vilom, Bhastrika Pranayama
10. Practice Bhramari, Sheetli, Ujjai Pranayam
11. Meditation  
Perform Meditation Asanas
12. Guided meditation with five minute and slowly increasing to higher durations.

Note:

1. Start and end of each session can be with appropriate Yoga prayers and chanting of Omkar.
2. Trainers can add similar asanas in practical sessions.
3. Students are to be instructed to practice the experiment performed at least twice a week as part of self learning practices.
4. Live demonstration by the trainer needs to be carried out during practical hours. Yogic Videos can be used as well .

**Reference Books:**

1. Asan Mudra Pranayam Bandha by Swami Satyanand Saraswati, Bihar School of Yoga
2. Patanjali Yog Sutra, Gita Press Gorakhpur
3. Yoga: A healthy way of Living, Secondary Stage NCERT
4. Yoga: A healthy way of Living, Upper Primary Stage NCERT