Three-Year Diploma Programme

Diploma of Engineering

Biomedical Engineering

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

1. Vision of the Department

The Department of Biomedical Engineering aspires to integrate innovative engineering principles into the domains of biology, physiology, and medicine, with a focus on addressing health and societal needs. This vision underscores a commitment to advancing the fundamentals of biomedical engineering, thereby contributing to the assessment of fitness-related issues for human health and societal well-being.

2. Mission of the Department

M1 To excel in biomedical engineering education, we integrate engineering with medical sciences, fostering academic excellence, research, and innovation.
M2 To usher in a new era in healthcare, we aim to impart comprehensive knowledge in Human Anatomy and Physiology intertwined with essential engineering principles.
M3 To meet the evolving demands of the healthcare sector, we offer essential training programs to cultivate the skills and knowledge required for future biomedical engineers.
M4 To address the dynamic demands of the healthcare sector, we provide essential programs aimed at cultivating the skills and knowledge necessary for aspiring biomedical engineers.
M5 To Train the students with good Practical skills.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the Diploma Biomedical Engineering curriculum enables graduates to attain.

PEO 1	Pursue successful career that encompasses the proficient analysis, design, and solution of real-time engineering problems, reflecting a commitment to excellence and contributing to innovative solutions in the dynamic landscape of the engineering profession.
PEO 2	Striving to excel in professional career, committed to pursuing lifelong learning, including higher education and research, for the continuous enhancement of skills.
PEO 3	Demonstrate interpersonal skills, leadership ability and team building to achieve organization goals and serve society with professional ethics and integrity.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of Study.

PLO 1	**Engineering knowledge:**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem analysis:**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PLO 3	**Design/development of solutions:**	Design solutions for complex engineering problems and design system components or processes that meet the specified needs

		with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
PLO 4	**Conduct investigations of complex problems:**	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.
PLO 5	**Modern tool usage:**	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.
PLO 6	**The engineer and society:**	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.
PLO 7	**Environment and sustainability:**	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 8	**Ethics:**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PLO 9	**Individual and team work:**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 10	**Communication:**	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.
PLO 11	**Project management and finance:**	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 multidisciplinary environments.
PLO 12	**Life-long learning:**	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.

5. Program Specific Learning Outcomes

PSO 1	Exhibit proficiency in conducting measurements and interpreting data from living systems, while effectively addressing challenges associated with the interaction between living and non-living materials and systems.
PSO 2	Graduates will be familiar with latest biomedical engineering software tools and equipment to analyse clinical problems.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester-1	19
Semester-2	20
Semester-3	17
Semester-4	22
Semester-5	26
Semester-6	23
Total Credits:	**127**

Category wise Credit distribution of the programme	
Category	**Credit**
Major Core	58
Minor Stream	30
Multidisciplinary	16
Ability Enhancement Course	4
Skill Enhancement Courses	4
Value added Courses	0
Summer Internship	2
Research Project/Dissertation	13
Total Credits:	**127**

7. Program Curriculum

Semester 1						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03605101	Environmental Science	0	2	0	0
2	03605151	Engineering Mechanics	3	3	0	0
3	03605152	Engineering Mechanics Lab	1	0	2	0
4	03609101	Engineering Graphics	1	1	0	0
5	03609102	Engineering Graphics Lab	2	0	4	0
6	03614101	Basic Electronics	3	3	0	0

7	03614102	Basic Electronics Lab	1	0	2	0
8	03691101	Mathematics - I	3	2	0	1
9	03692154	Basic Physics Lab	1	0	2	0
10	03692155	Basic Physics	3	3	0	0
11	03693103	Communication Skills - I	1	1	0	0
Total			**19**	**15**	**10**	**1**
Semester 2						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
12	03602107	Applied Chemistry	3	3	0	0
13	03602108	Applied Chemistry Lab	1	0	2	0
14	03606102	Introduction to IT Systems Lab	2	0	4	0
15	03609154	Engineering Workshop Practice	2	0	4	0
16	03614151	Basic Biology	3	3	0	0
17	03614153	Digital Logic Design	3	3	0	0
18	03614154	Digital Logic Design Lab	1	0	2	0
19	03691151	Mathematics-II	4	3	0	1
20	03693153	Communication Skills - II	1	1	0	0
Total			**20**	**13**	**12**	**1**
Semester 3						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
21	03600201	Entrepreneurship and Start-ups	1	1	0	0
22	03614203	Analog Electronics	4	4	0	0
23	03614204	Analog Electronics Lab	1	0	2	0
24	03614205	Basics of Bio Transducers	4	4	0	0
25	03614206	Basics of Bio Transducers Lab	1	0	2	0
26	03614209	Life Science	4	4	0	0
27	03614210	Life Science Lab	1	0	2	0
28	03693203	Professional Communication and Critical Thinking	1	1	0	0

Total			17	14	6	0
Semester 4						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
29	03600251	Essence of Indian Knowledge and Tradition	0	2	0	0
30	03614251	Hospital Planning and Clinical Services	3	3	0	0
31	03614255	Analytical Instrumentation	4	4	0	0
32	03614256	Analytical Instrumentation Lab	1	0	2	0
33	03614257	Biomechanics	3	3	0	0
34	03614259	Microprocessor and Assembly Language	4	4	0	0
35	03614260	Microprocessor and Assembly Language Lab	1	0	2	0
36	03614261	Diagnostic Instrumentation	3	3	0	0
37	03614262	Diagnostic Instrumentation Lab	1	0	2	0
38	03614266	Minor Project	1	0	2	0
39	03693251	Employability Skills	1	1	0	0
Total			**22**	**20**	**8**	**0**
Semester 5						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
40	03614301	Medical Imaging Techniques	4	4	0	0
41	03614302	Medical Imaging Techniques Lab	1	0	2	0
42	03614303	Life Threatening Instrumentation	3	3	0	0
43	03614304	Life Threatening Instrumentation Lab	1	0	2	0
44	03614305	Therapeutic Instrumentation	3	3	0	0
45	03614306	Therapeutic Instrumentation Lab	1	0	2	0
46	03614309	Microcontroller and Interfacing	4	4	0	0
47	03614310	Microcontroller and Interfacing Lab	1	0	2	0
48	03614312	Summer Internship	2	0	0	0
49	03614318	Major Project-I	6	0	12	0
Total			**26**	**14**	**20**	**0**

Semester 6						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
50	03600351	Indian Constitution	0	2	0	0
51	03614351	Signal Processing for Biomedical	4	4	0	0
52	03614352	Signal Processing for Biomedical Lab	1	0	2	0
53	03614353	Rehabilitation Engineering	3	3	0	0
54	03614354	Rehabilitation Engineering Lab	1	0	2	0
55	03614360	Major Project-II	6	0	12	0
56		Program Elective - I (Compulsory Subjects :1)	3	3	0	0
57		Program Elective - II (Compulsory Subjects :1)	3	3	0	0
58		Program Elective Lab- I (Compulsory Subjects :1)	1	0	2	0
59		Program Elective Lab- II (Compulsory Subjects :1)	1	0	2	0
Total			**23**	**15**	**20**	**0**
Program Elective - I						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03614381	Telemedical Instrumentation	3	3	0	0
2	03614383	Artificial Organ	3	3	0	0
Program Elective Lab- I						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03614382	Telemedical Instrumentation Lab	1	0	2	0
2	03614384	Artificial Organ Lab	1	0	2	0
Program Elective - II						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03614385	Biomaterials and Implants	3	3	0	0
2	03614387	Tissue Engineering	3	3	0	0

Program Elective Lab- II						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03614386	Biomaterials and Implants Lab	1	0	2	0
2	03614388	Tissue Engineering Lab	1	0	2	0

SEMESTER 1

a. **Course Name:** - Environmental Science (Audit Course)

b. **Course Code:** 03605101

c. **Prerequisite:** Zeal to learn the subject

d. **Rationale:** The course is designed to give developers a general awareness of these and related issues so that every student will start acting as a responsible citizen to make the country and the world a better place to live in.

e. **Course Learning Objective:**

CLOBJ 1	Understanding Ecosystem Structure and Describe the components of an ecosystem, including both biotic and abiotic factors and Understand the significance of these cycles in maintaining ecosystem balance.
CLOBJ 2	Evaluate air and noise pollution sources, effects, and control measures, considering both natural and anthropogenic factors. Studying Air and Noise Pollution and Identify common air pollutants and their sources. Evaluate noise pollution sources, measurement techniques, and regulatory measures
CLOBJ 3	Analyze characteristics such as turbidity, pH, BOD, and COD in water. Examine primary, secondary, and tertiary methods of wastewater treatment. Investigate causes, effects, and preventive measures of soil pollution.
CLOBJ 4	Explore the basics of solar energy and different solar technologies and Evaluate biomass as an energy source, including its thermal characteristics and biogas production. Investigate new energy sources like hydrogen, ocean energy, tidal energy, and geothermal energy.
CLOBJ 5	Understand the principles of the 3Rs (Reduce, Reuse, Recycle) in solid waste management. Evaluate methods of energy recovery and disposal, including sanitary landfill for municipal solid waste.

f. **Course Learning Outcomes:**

CLO 1	Understand the ecosystem and terminology and solve various engineering problems applying
CLO 2	Ecosystem knowledge to produce eco – friendly products.

CLO 3	Understand the suitable air, the extent of noise pollution, and control measures and acts.
CLO 4	Understand the water and soil pollution, and control measures and acts.
CLO 5	Understand different renewable energy resources and efficient process of harvesting.
CLO 6	Understand solid Waste Management, ISO 14000 & Environmental Management.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	0	20	20	-	-	-	40

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content

Course Content

W - Weightage (%) , **T** - Teaching hours

Sr.	Topics	W	T
1	**Ecosystem** Structure of ecosystem, Biotic & Abiotic components, Food chain and food web Carbon, Nitrogen, Sulphur, Phosphorus cycle. Global warming -Causes, effects, process, Green House Effect, Ozone depletion.	15	3
2	**Air and Noise Pollution** Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler). Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator,Electrostatic Precipitator). Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler, Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution,Noise pollution (Regulation and Control) Rules, 2000.	22	6
3	**Water and Soil Pollution** Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition, calculation. Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis), Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.	24	8

4	**Renewable Sources of energy** Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector.Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer.Solar stills. Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas. Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy. New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin and power plants of geothermal energy.	**24**	**8**
5	**Solid Waste management** Solid waste generation- Sources and characteristics of : Municipal solid waste, E- waste, biomedical waste.Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries.Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste.	**15**	**3**

i. Text Book and Reference Book:

Reference Books	
1.	**Principles of Solar Engineering** By Yogi Goswami D., Frank Kreith, Jan F. Kreider | Taylor & Francis, 2003 | Second
2.	**Environmental Studies** By M.P. Poonia, S.C. Sharma | Khanna Publishing House, NewDelhi | 2017
3.	**Renewable Energy Sources** By Twidell J.W. and Weir. A | EFN Spon Ltd
4.	**Environmental Sciences** By Daniel B Botkin & Edward A Keller, | John Wiley & Sons
5.	**Air Pollution** By M. N. Rao and H. V. N. Rao | Tata McGraw-Hill Publishing Company
6.	**Environmental Pollution Control Engineering** By Rao C.S | 2nd edition
7.	**Solid Waste Treatment and Disposal** By G. Tchabanoglous | McGraw Hill Pub.

a. Course Name: Engineering Mechanics

b. Course Code: 03605151

c. Prerequisite: Knowledge of Applied science.

d. Rationale: Engineering mechanics is the main subject of mechanical engineering which gives a basic base to other subjects like strength of materials, manufacturing process. The goal of this Engineering Mechanics course is to expose students to problems in mechanics as applied to plausibly real-world scenarios.

e. Course Learning Objective:

CLOBJ 1	Identify force systems in diverse engineering scenarios through the application of fundamental mechanics principles.

CLOBJ 2	To impart knowledge about calculate the centroid and center of gravity for various components within engineering systems.
CLOBJ 3	To impart knowledge about force systems and methods to determine resultant.
CLOBJ 4	To impart knowledge about force systems and methods to determine resultant.
CLOBJ 5	Apply the principles of friction across various conditions to achieve practical objectives.
CLOBJ 6	Select appropriate eco-friendly lifting machines for specific purposes, considering relevant factors such as efficiency and sustainability.

f. Course Learning Outcomes:

CLO 1	Identify the force systems for given conditions by applying the basics of mechanics.
CLO 2	Find out the centroid and centre of gravity of various components in engineering systems.
CLO 3	Determine unknown force(s) of different engineering systems.
CLO 4	Determine unknown force(s) of different engineering systems.
CLO 5	Apply the principles of friction in various conditions for useful purposes
CLO 6	Select the eco-friendly relevant simple lifting machine(s) for given purposes

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	**Content**	**Weightage**	**Teaching Hours**
1	**Basics of Mechanics:** Significance and relevance of Mechanics, Applied mechanics, Statics, Dynamics. Space, time, mass, particle, flexible body and rigid body. Scalar and vector quantity, Units of measurement (SI units) - Fundamental units and derived units.	**10%**	**2**
2	**Centroid and Centre of Gravity:** Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle) Centroid of composite figures composed of not more than three geometrical figures. Centre of Gravity of simple solids (Cube, cuboids, cone, cylinder, sphere, hemisphere) Centre of Gravity of composite solids composed of not more than two simple solids.	**10%**	**6**

3	**Coplanar Concurrent Forces:** Force – Unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Newton's first, second and third Law of motion Principle of transmissibility of force, Principle of superposition of force, Force system and its classification. Lami's Theorem – statement and explanation, Application for various engineering problems. Resolution of a force .Composition of forces – Resultant, analytical method for determination of resultant for concurrent, non-concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces.	**25%**	**10**
4	**Equilibrium and Coplanar Non Concurrent Forces:** Types of Equilibrium, Equilibrant, Free body and Free body diagram, Analytical and graphical methods of analyzing equilibrium. Moment and couple, Varignon's Theorem. Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, uniformly distributed load, couple), Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and uniformly distributed load. Beam reaction graphically for simply supported beam subjected to vertical point loads only	**25%**	**10**
5	**Friction:** Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction. Equilibrium of bodies on level surface subjected to force parallel and inclined to plane. Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. Ladder Friction, Engineering Problems.	**10%**	**6**
6	**Simple Lifting Machine:** Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, Work – work done , force displacement diagram, Power , Engineering Problems Energy – Kinetic & Potential energy and Engineering Problems. Law of machine. Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines.	**20%**	**8**

i. Text Book and Reference Book:

1. "Applied Mechanics" by H. J. Shah and S. B. Junarkar.
2. "A Text Book of Engineering Mechanics" by Bansal R K.
3. "Engineering Mechanics" by J.L. Meriam, and L.G.Kraige.
4. "Engineering Mechanics" by S.S. Bhavikatti and K. G. Rajashekarappa

a. **Course Name:** Engineering Mechanics Lab

b. **Course Code:** 03605152

c. **Prerequisite:** Knowledge of Applied science

d. **Rationale:** Engineering mechanics is the main subject of mechanical engineering which gives a basic base to other subjects like strength of materials, manufacturing process. The goal of this Engineering Mechanics course is to expose students to problems in mechanics as applied to plausibly real-world scenarios.

e. **Course Learning Objective:**

CLOBJ 1	Identify force systems in diverse engineering scenarios through the application of fundamental mechanics principles.
CLOBJ 2	To impart knowledge about calculate the centroid and center of gravity for various components within engineering systems.
CLOBJ 3	To impart knowledge about force systems and methods to determine resultant.
CLOBJ 4	To impart knowledge about force systems and methods to determine resultant.
CLOBJ 5	Apply the principles of friction across various conditions to achieve practical objectives.
CLOBJ 6	Select appropriate eco-friendly lifting machines for specific purposes, considering relevant factors such as efficiency and sustainability.

f. **Course Learning Outcomes:**

CLO 1	Identify the force systems for given conditions by applying the basics of mechanics.
CLO 2	Find out the centroid and centre of gravity of various components in engineering systems.
CLO 3	Determine unknown force(s) of different engineering systems.
CLO 4	Determine unknown force(s) of different engineering systems.
CLO 5	Apply the principles of friction in various conditions for useful purposes
CLO 6	Select the eco-friendly relevant simple lifting machine(s) for given purposes

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	

0	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Text Book and Reference Book:

1. "Applied Mechanics" by H. J. Shah and S. B. Junarkar.
2. "A Text Book of Engineering Mechanics" by Bansal R K.
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4. "Engineering Mechanics" by S.S. Bhavikatti and K. G. Rajashekarappa

i. List of Experiments:

Exp. No.	Name of the Experiment
1	Law of Parallelogram: Verify and calculate resultant force through Law of Parallelogram.
2	Triangle Law of Forces: Verify and calculate resultant force through triangle Law of Forces.
3	Lami's Theorem: Verify and calculate resultant force through Lami's Theorem.
4	Polygon Law of Forces: Verify and calculate resultant force through Polygon Law of Forces.
5	Reactions in beam through Graphical & analytical method: Verify reactions in beam through Graphical & analytical method
6	Co efficient of Sliding Friction and angle of repose: Calculate Co efficient of Sliding Friction and angle of repose for different surfaces– Wood, Glass
7	Simple machines: To find out efficiency, velocity ratio and M.A for differential wheel and axle
8	Simple screw jack: To find out efficiency, velocity ratio and M.A for simple lifting machine using simple screw jack.
9	Centroid and Centre of Gravity: Solve numerical problems on Centroid and Centre of Gravity.

a. Course Name: Engineering Graphics

b. Course Code: 03609101

c. Prerequisite: Drawing basic knowledge

d. Rationale: Engineering drawing is an effective language of engineers. It is the foundation block which strengthens the engineering & technological structure. It is the transmitting link between ideas and realization. It is an attempt to develop fundamental Understanding and application of engineering drawing. It covers knowledge & application of drawing instruments & also familiarizes the learner about Bureau of Indian standards.

e. Course Learning Objective:

CLOBJ 1	The course is aimed at developing Basic Graphic skills.

CLOBJ 2	Develop Skills In Preparation Of Basic Drawings.
CLOBJ 3	Skills in Reading and Interpretation of Engineering Drawings.

f. Course Learning Outcomes:

CLO 1	Students should be able to demonstrate proficiency in creating and interpreting technical drawings using industry-standard drafting techniques and tools.
CLO 2	Understand and apply principles of orthographic projection, auxiliary views, section views, and geometric construction to accurately represent three-dimensional objects on a two-dimensional plane..
CLO 3	It is an attempt to develop fundamental understanding and application of engineering drawing.
CLO 4	It covers Knowledge & application of drawing instruments & also familiarizes the learner about Bureau of Indian Standards.
CLO 5	The curriculum aims at developing the ability to draw and read various drawings, curves & Projections.
CLO 6	Select and construct appropriate drawing scales, use drawing equipment's, and understand Indian Standards of engineering drawing.
CLO 7	Develop the ability to visualize objects in three dimensions from two-dimensional representations, aiding in the understanding of complex engineering designs.
CLO 8	Apply engineering graphics principles to solve design problems, analyze engineering drawings for accuracy and completeness, and make informed decisions to improve design quality.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**0**	**1**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	**Content**	**Weightage**	**Teaching Hours**
1	**Drawing equipment's, instruments and materials.** Equipment's-types, specifications, method to use them,	**4**	**1**

	applications. Instruments-types, specifications, methods to use them and applications. Pencils-grades, applications, types of points and applications. Other materials-types and applications.		
2	**Planning, Layout And Scaling Of Drawing** Follow and apply standard practice as per bureau of I.S. for planning and layout, Choose appropriate scale factor for the drawing as per given situation	**4**	**0**
3	**Lines, Lettering and dimensioning:** Different types of lines. Vertical capital and lower case letters. Inclined capital and lower case letters. Numerals and Greek alphabets. Dimensioning methods. Aligned method. Unilateral with chain, parallel, progressive and combined dimensioning.	**4**	**0**
4	**Geometric Construction:** Geometric construction related with line like bisecting a line, to draw perpendicular with a given line, divide a line, etc. Geometric construction related with angle like bisect an angle, trisect an angle, etc. To construct polygon. Triangle, Square / Rectangle, Pentagon with special method. d: Hexagon with special method. To draw tangents. Geometric construction related with circle & arc.	**7**	**2**
5	**Engineering Curves:** Conic sections: Concept and understanding of focus, directory, vertex and eccentricity and drawing of conic sections. Using various methods, understand construction of: Ellipse. Parabola. Hyperbola. Cycloidal Curves (Cycloid, Epicycloid, Hypocycloid) Involutes. Involutes of a circle, Involutes of a polygon, Spiral (Archimedean spiral only).	**22**	**3**
6	Projection Of Points, Lines and Planes Reference planes, orthographic projections. Concept of quadrant.1st angle and 3rd angle projection and their symbols. Projection of points. Projection of lines – determination of true length and inclinations for following cases. Line parallel to one or both the plane. Line perpendicular to one of the plane. Line inclined to one plane and parallel to another. Line inclined to both the planes. Projection of Planes: Types of planes, Projection of planes parallel to one of the reference planes, Projection of plane inclined to one reference plane and perpendicular to another, Projection of planes inclined to both reference planes.	**25**	**2**
7	**Orthographic Projections:** Types of projections-orthographic, perspective, isometric and oblique: concept and applications. Various term associated with orthographic projections. Theory of projection, Methods of projection, Orthographic projection, Planes of projection. Conversion of simple pictorial views into Orthographic views. Illustrative problems on orthographic projection B.I.S. code of practice	**22**	**3**
8	**Isometric Projections:** Isometric axis, lines and planes. Isometric scales. Isometric view and isometric drawing. Difference between isometric projection and isometric drawing. Illustrative problems limited to objects containing lines, circles and arcs shape only.	**12**	**3**

i. Text Book and Reference Book:

1. "ENGINEERING GRAPHICS" By P. J. Shah | S. Chand & Co., New Delhi Publications.
2. "A Text Book of Engineering Graphics" By P.J.Shah | S.Chand & Company Ltd., New

Delhi

3. "Engineering Drawing" By P.J.Shah. | S.Chand, New Delhi

a. Course Name: Engineering Graphics Lab

b. Course Code: 03609102

c. Prerequisite: Zeal to learn the subject

d. Rationale: Engineering Drawing is an effective language of engineers. It is the foundation block which strengthens the engineering & technological structure. Moreover, it is the transmitting link between ideas and realization.

e. Course Learning Objective:

CLOBJ 1	Instruct the utility of drafting & modeling packages in orthographic and isometric drawings.
CLOBJ 2	Train the usage of 2D and 3D modeling.
CLOBJ 3	Instruct graphical representation of machine components.

f. Course Learning Outcomes:

CLO 1	Select and construct appropriate drawing scales, use drawing equipment's, and understand Indian Standards of engineering drawing.
CLO 2	Draw views of given object and components.
CLO 3	Sketch orthographic projections into isometric projections and vice versa.
CLO 4	Apply computer aided drafting tools to create 2D engineering drawings.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**4**	**2**	**-**	**-**	**100**	**-**	**0**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Text Book and Reference Book:

1. Engineering Drawing Practice for Schools and Colleges By Bureau of Indian Standards | Government of India, Pub. Year 1998
2. Engineering Drawing By N. D. Bhatt | Charotar Publishing House, Pub. Year 2010

3. Engineering Graphics & Design By Jain & Gautam | Khanna Publishing House
4. Engineering Drawing By D. A. Jolhe | Tata McGraw Hill Edu
5. Engineering Drawing By R. K. Dhawan | S. Chand and Company

i. List of Experiments:

Exp. No.	Name of the Experiment
1	Use of drawing instruments
2	Geometric construction
3	Engineering curves – i
4	Engineering curves – ii
5	Projections of points and line
6	Projections of plane
7	Orthographic projections
8	Isometric drawings

a. Course Name: Mathematics I

b. Course Code: 03691101

c. Prerequisite: Knowledge of basic concept studied till 10th std.

d. Rationale: The study of mathematics is an important requirement for the understanding and development of any branch of engineering. The purpose of teaching mathematics to diploma engineering students is to impart them basic knowledge of mathematics which is needed for full understanding and study of Engineering subjects**.**

e. Course Learning Objective:

CLOBJ 1	Apply logarithm in engineering calculation
CLOBJ 2	Analyze rational fraction into sum of partial fraction in engineering problems
CLOBJ 3	Learn trigonometric functions and its graph for engineering
CLOBJ 4	Understand the concepts of complex numbers in engineering
CLOBJ 5	Understand the use of limit and functions in engineering
CLOBJ 6	Learn Differentiation of different functions in engineering

f. Course Learning Outcomes:

CLO 1	Understand the concepts logarithm with different examples
CLO 2	Understand rational fraction into sum of partial fraction in engineering

CLO 3	Understand trigonometric functions and its graph with different examples
CLO 4	Understand the concepts of complex numbers by using examples
CLO 5	Apply limit to functions by using examples
CLO 6	Apply derivative to different functions with examples

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	1	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Logarithms:** Definition, Logarithm as a transformation, Antilogarithm, Rules of Logarithms and examples, Use logarithmic functions for simplifying arithmetic computations. **Partial fractions:** Definition of partial fractions. Types of partial fraction (Denominator containing non-repeated linear factors, repeated linear factors and irreducible non-repeated quadratic factors).	**17%**	**4**
2	**Trigonometry:** Concept of angles, measurement of angles in degrees, grades and radians and their conversions, T-Ratios of Allied angles (without proof), Trigonometric identities, Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T-Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2). Graphs of all trigonometric functions	**23%**	**7**
3	**Permutations and Combinations:** Value of nPr and nCr with related examples, First principal of Mathematical Induction(without proof) **Binomial theorem:** Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for rational index (expansion without proof) first and second binomial approximation with applications to engineering problems	**9%**	**3**
4	**Complex Numbers:** Definition of a complex number, real and imaginary parts of a complex number, Polar and Cartesian representation of complex number, Conjugate of complex number, Geometric representation of complex numbers and their operations, Modules and Amplitude form, De Moivre's Theorem, Root of Complex Number, Use of De Moivre's Theorem to simplify mathematical expressions.	**17%**	**4**

5	**Calculus:** Definition of function; Concept of limits and standard forms of limits $\lim_{x \to a} (1+x)^{\frac{1}{x}}$ nd Definition of continuous function and examples. Definition of derivative, differentiation of standard function by first principle, Rule of Differentiation, Differentiation of algebraic, trigonometric, Exponential, Logarithmic, Implicit functions and Composite functions, Higher order derivatives.	**34%**	**10**

i. Text Book and Reference Book:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics (Diploma Stream), H.K. Dass, S. Chand Publishing
3. Mathematics for Polytechnic, S.P. Deshpande, Pune Vidyarthi Griha Prakashan.
4. Polytechnic Mathematics (Made Easy)(Applied Mathematics) , Manjeet Singh

a. Course Name: Communication Skills-I

b. Course Code: 03693103

c. Prerequisite: Basic Knowledge of English

d. Rationale: Communication confidence laced with knowledge of English grammar is essential for all engineers.

e. Course Learning Objective:

CLOBJ 1	Encourage students to analyze information, evaluate arguments, and develop reasoned conclusions.
CLOBJ 2	Foster the ability to identify and solve complex problems through logical reasoning and creativity.
CLOBJ 3	Develop effective written, verbal, and non-verbal communication skills to express ideas clearly and persuasively.
CLOBJ 4	Teach students to work effectively in teams, valuing diverse perspectives and contributing positively to group efforts.
CLOBJ 5	Cultivate imaginative thinking and the ability to generate original ideas and solutions.
CLOBJ 6	Equip students with the skills to locate, evaluate, and ethically use information from various sources.

f. Course Learning Outcomes:

CLO 1	Analyze complex issues, evaluate evidence, and develop reasoned arguments to support their conclusions.

CLO 2	Identify problems, explore potential solutions, and implement strategies to address challenges effectively.
CLO 3	Articulate ideas clearly and persuasively in written, verbal, and non-verbal forms, adapting their communication style to different audiences and purposes.
CLO 4	Locate and critically evaluate information from various sources, demonstrating information literacy skills to support their learning and decision-making.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	0	0	1	-	100	-	-	-	100

Lect. - Lecture, **Tut** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** – Continuous Evaluatio

Note: 15 Hours of additional sessions will be taken (within the semester) to match up 30 hours content.

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Ice breaker + Introducing your friend**: This is one activity which will build the bond between the students i the class and work as a team in the task given to them. The students will be asked to introduce their new best friend in the class. This will ensure that the bond being created here will stay strong and also breaks the ice between them.	05%	01
2	**Picture connector**: In this class the students will be trained to form a logical connection between a set of pictures which will be shared with them. This geared towards building creativity and presentation skills.	05%	01
3	**Crazy Scientist**: The students will be taught the importance of invention and innovation using some examples that changed the world the way it worked.	05%	01
4	**Shopping role play**: This activity topic gears towards making students do role play based on shopping scenarios. It involves giving them a scenario and asking them to further develop the idea in a very interesting manner, then going on to enact it.	05%	01
5	**Grammar** Parts of speech, Active and Passive voice, Tenses	20%	10

6	**Communication: Theory & Practice** Basics of communication: Introduction ,meaning, definition , Process of communication Types of communication: Formal, Informal , Verbal / Non verbal and Written barriers to effective communication 7 Cs of effective communication: (considerate ,concrete concise , clear, complete , correct and courteous) Technical Communication :	12%	05
7	**Soft Skills** for Professional excellence I**ntroduction** :Soft skills and hard skills , Inportance of Soft Skills	12%	02
8	**Debate**: Students are trained to let go of inhibitions and come forward and speak openly on passionate topics. The students will be divided into teams and made to share their ideas and views on the topics.	05%	01
9	**Extempore**: To change the average speakers in the class to some of the best Orator. This will be done by making the students give variety of impromptu speeches in front of the class.	05%	01
10	**Letter Writing** Types of letters-Inquiry letter, Order letter, Complaint letter, Adjustment, Request letter, Recommendation letter Format of letters	12%	02
11	**Reading Comprehension**: Dabbawalahs A Snake in the grass Internet – Dr. Jagdish Joshi	14%	05
	Total	**100**	**60**

***Continuous Evaluation:**

It consists of

1. Phase I Exam-35 Marks(Hybrid or Offline Mode)
2. Phase II Exam -35 Marks (Hybrid or Offline Mode)
3. Activities – (Listening and Speaking) -10+10=20 Marks
4. Attendance -10 Marks

The passing marks for Continous Evaluation will be 40 out of 100.There will not be any re-test.

J. Text Book and Reference Books:

1. Active English –Almas Juneja and Vaseem Qureshi-Macmillan Publishers India Ltd
2. English- Prof. Pradyuman Raj, Prof. Rakhi Moghe, Ms. Anisha Modi
3. Technical Communication –Principles & Practice-IInd Edition by Meenakshi Raman & Sangeeta Sharma.
4. Effective Technical Communication by Dr.Bharti Kukreja & Dr. Anupama Jain
5. J.D.O'Connor. Better English Pronunciation. Cambridge: Cambridge University Press, 1980.

6. Lindley Murray. An English Grammar: Comprehending Principles and Rules. London:Wilson & Sons, 1908.
7. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi (Re-vised Edition 2018)
8. Margaret M. Maison. Examine your English. Orient Longman: New Delhi, 1964.
9. M.Ashraf Rizvi. Effective Communication. Mc-Graw Hill: Delhi, 2002.
10. A Ready Reckoner –Dineshbhai J. Shah, Dr.Janakbhai I. Shah,Bhartiben P. Shah.
11. Oxford Dictionary
12. Roget's Theasaurus of English Words and Phrases.

SEMESTER 2

a. **Course Name:** Basic Biology
b. **Course Code:** 03614151
c. **Prerequisite:** Understanding of Basic knowledge of human body structure and their functions.
d. **Rationale:** To encourage students to develop understanding of the structure and functions of cells, tissues, organs within the body. Students should gain familiarities with the cell and tissues, their structure and functions. Understanding of their importance in design of biomedical devices. The subject also provides increased awareness of personal health. The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency. Describe the principle functions of the major body cells and organs and interrelationship between them.

e. **Course Learning Objective:**

CLOBJ 1	Apply the scientific method, including hypothesis formation, experimentation, observation, data analysis, and drawing conclusions.
CLOBJ 2	Understand the structure and function of cells, including differences between prokaryotic and eukaryotic cells, and the roles of organelles within the cell.
CLOBJ 3	Learn the principles of genetics, including the structure of DNA, gene expression, and the mechanisms of inheritance. They will also be able to explain Mendelian genetics and patterns of inheritance.
CLOBJ 4	Grasp the fundamental concepts of evolution, natural selection, and adaptation. They will be able to describe how evolutionary processes lead to the diversity of life.
CLOBJ 5	Learn about the basics of metabolism, including photosynthesis, cellular respiration, and the energy transfer within living organisms.

f. **Course Learning Outcomes:**

CLO 1	Describe and explain key biological concepts, such as cell theory, genetics, evolution, and ecology.
CLO 2	Apply the scientific method to design, conduct, and analyse biological experiments, including data collection and interpretation.
CLO 3	Identify and describe the structures of prokaryotic and eukaryotic cells and explain the functions of various organelles.

CLO 4	Recognize and discuss the ethical, social, and environmental implications of biological research and technologies.
CLO 5	Describe the components of ecosystems, explain ecological interactions, and discuss the impact of human activities on the environment.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage (%)	Teaching Hours
1	**Fundamentals of Basic Biology** Introduction of human anatomy and human physiology, Anatomy Anatomical planes such as median, parasagittal, coronal, axial planes and anatomical directional terms like anterior, posterior, superior, inferior, proximal, distal, medial, lateral. Physiology-Mechanism of respiration	**20 %**	**7**
2	**Cell and Tissues** Cell- Structure and functions of cell including different organelles like cell membrane ,nucleus ,cytoplasm, endoplasmic reticulum, lysosomes, Golgi apparatus, mitochondria, ribosome. Tissues-Types of tissues such as epithelial, connective, nervous and muscle tissues.	**20 %**	**9**
3	**Blood** Composition of blood and its functions-including plasma Properties of blood, plasma proteins, RBC Structure and functions. WBC- Types, Platelets- Structure and life span. Blood groups: ABO grouping system and RH grouping system	**20 %**	**6**
4	**Glands and Hormones** Endocrine System-different endocrine glands and hormones and their location, functions-hypothalamus, pituitary, pineal, adrenal, thyroid, parathyroid, pancreas etc.	**10 %**	**4**
5	**Skin** Definition of skin, its diagram, Structure and functions of different layers of skin. Common skin diseases.	**20 %**	**8**
6	**Special Senses** Vision: structure of Eye, optic nerve, Visual acuity. Hearing: structure of Ear, Tympanic membrane, cochlea, Hearing mechanics and abnormality, Deafness. Nose: sense of smell. Tongue: sense of taste	**10%**	**10**
	Total	**100 %**	**44**

i. **Text books:**

1. Dr.Padma Sanghan, Human anatomy and physiology made easy, Akshat, 2010.
2. Ross and Wilson, Human anatomy and physiology, Ross and Wilson Elsevier, 2010.
3. K. Sembulingam & Prema Sembulingam, Essentials of medical physiology, Jaypee Brothers Medical Publishers, 2019.

a. **Course Name:** Applied Chemistry

b. **Course Code:** 03602107

c. **Prerequisite:** Understanding of Basic knowledge of Science for the application.

d. **Rationale:** Science is fundamental to technician courses, aiming to cultivate scientific inquiry and cause-and-effect reasoning in students. Chemistry, as applied science, plays a crucial role. Studying chemical concepts like bonding, corrosion, and organic chemistry, along with engineering materials such as polymers and lubricants, enhances understanding of engineering subjects. Chemistry focuses on the changes in matter's structure and properties, forming the basis of engineering processes. Teaching should foster aptitude and predictive skills. A strong science foundation aids students' self-development and adaptability to evolving innovations.

e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of existence of material in nature
CLOBJ 2	Acquaint with the various mechanisms of natural phenomena.
CLOBJ 3	Explain the characteristics of materials, substances, and compounds.
CLOBJ 4	Develop skills to conduct experiments.
CLOBJ 5	Apply analytical techniques to solve engineering problems and perform material performance analysis.

f. **Course Learning Outcomes:**

CLO 1	Understand the concept of Existence of material in nature.
CLO 2	Acquainted with the various Mechanism of natural phenomenon.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Develop skills to do experiments.
CLO 5	Apply analytical techniques to solve the engineering problem and performance analysis of material.

g. Teaching and Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-		3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Topic	Weightage	Teaching Hrs.
1	**Chemical Bandings and Catalysis**: 1. Rutherford model of atom, Bohr's theory, Heisenberg uncertainty principle, Quantum numbers – orbital concept. 2. Shapes of s,p and d orbitals, Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration. 3. Theory Of Valency 4. Electronic Configuration 5. Types of chemical bonds i. Electrovalent bond, & its characteristics ii. Covalent bond & its characteristics iii. Co- ordinate bond iv. Hydrogen bond, its types and Significance v. Metallic bond, Explanation of Metallic properties. vi. Electron Sea Model 6. Intermolecular force of attraction 7. Vander Waals force of attraction 8. Catalysis, i. Types of catalysis ii. Theory ofCatalysis iii. Characteristics of Catalyst 9. Types of Catalyst i. Positive Catalyst ii. Negative Catalyst	10	6

	iii. Auto-catalyst Catalytic Promoter and Catalytic inhibitor Industrial Application of Catalyst		
2	**Concepts of ElectroChemistry**: 1. Introduction 2. Arrhenius theory of ionization. 3. Degree of ionization i. Factors affecting the degree of ionization 4. Definition of pH i. pH of acid, base and neutral solution ii. pH calculations of acid, base and salt solution at different concentration iii. Importance of pH in various fields. 5. Definition of buffer solution. i. Buffer Action & Types of buffer Solution. ii. Application of buffer solutions. 6. Electrolytes and Non-electrolytes Types of electrolytes Definition the term ` Electrode ' the Types of Electrodes Inert electrode, Working electrode & Reference electrode; with suitable Illustrations. Construction & Working of reference electrode: 1. Hydrogen electrode 2. Calomel electrode 3. Quinhydrone electrode 4. Glass electrode 5. Ag/ Agcl/ Kcl electrode • Kohlrausch Law of independent Migration of ions. 7. Construction and working of electrochemical cell 8. Standard conditions 9. Standard hydrogen electrodes 10. Nernst theory of single electrode potential & Nernstequation 11. Electrochemical series, galvanic series	**20**	**8**

	12. Electrolysis, Faradays laws of electrolysis 13. Industrial application of Electrolysis 14. conductance of solution (a) Conductivity (b)Specific Conductivity (c) Equivalent conductivity (d) Molar conductivity		
3	**Corrosion of metals & its prevention**: Definition of corrosion 1. Types of corrosion i. Dry corrosion: Oxidation corrosion mechanism corrosion-mechanism , Nature of oxidefilm ii. Wet corrosion-mechanism iii. Concentration cell corrosion 2. Pitting corrosion 3. Waterline corrosion 4. Crevice corrosion 5. Stress Corrosion 6. Erosion Corrosion 7. Factors affecting the rate of corrosion,- Nature of film, Nature of Environment,PH of Solution, Area of cathode anode and, Temperature,Moisture,Purity of metal 8. Methods of prevention of corrosion- 9. Modification of environment, 10. Modification of the properties of metal, 11. Use of protective coatings. 12. Anodic and cathodic protection, Modification in design and choice of material	**10**	**5**
4	**Water Treatment**: Graphical presentation of water distribution on Earth (pie or bar diagram) . Hard water and soft water. 1. Types of hardness of water i. Salts producing hardness of water. ii. Method to express the hardness of water. 2. Estimation of total hardness by EDTA Method i. Examples to calculate the hardness 3. Effect of hard water in Boiler operation i. Scale and sludge formation and it'sPrevention	**20**	**7**

	ii. Priming and foaming and it's prevention. 4.4.3. Caustic embrittlement and it's prevention. Corrosion and it's prevention. 1. Softening of Water i. Soda-Lime process ii. Permutit process iii. Ion Exchange process iv. Reverse Osmosis process 2. Treatment of Drinking water i. Sedimentation ii. Coagulation iii. Filtration iv. Sterilization of water by chlorination Break-point chlorination-Graph v. enlist Indian standard specification of drinking water		
5	**Lubricants**: 1. Introduction and definition of lubricants and lubrication 2. function of lubricants 3. Types of lubrication i. Fluid film lubrication. ii. Boundary lubrication 4. Classification of lubricants i. Solid lubricants ii. Semi-solid lubricants iii. Liquid lubricants iv. Synthetic oils 5. Physical Properties of lubricants and their significance like i. Viscosity and viscosity index ii. Flash point and fire point iii. Pour point and cloud point iv. oiliness 6. Chemical Properties of lubricants like i. Soaponification value	**10**	**5**

	ii. Neutralization number iii. Emulsification number 7. Selection of lubricants for i. Gears ii. Cutting tools iii. Steam turbine		
6	**Polymer, Elastomers & Adhesives**: Introduction and Definition of Polymer and Monomer Classification of Polymer on basis of Molecular structure as Linear, Branch and Cross-linked polymers Classification on basis of monomers homopolymer and co polymer) Classification of Polymers on of Thermal behaviour (Thermoplastics& Thermosetting) Types polymerization Reaction i. Addition Polymerization ii. Condensation Polymerization Synthesis, properties and application of i. Polyethylene ii. Polypropylene iii. Polyvinyl chloride iv. Teflon v. Polystyrene vi. Phenol formaldehyde vii. Acrylonitrile viii. Epoxy Resin Define the term:- elastomers Natural rubber and its properties vulcanization of rubber Synthetic rubber, Synthesis, properties and uses i. Buna-S Rubber ii. Buna-N Rubber iii. Neoprene Rubber Definition of adhesives and Examples i. Characteristics of adhesives ication of adhesives and theiruses.	**20**	**6**
7	**Chemistry of Fuels :** 7.1 Definition of fuel and combustion of fuel, 7.2 classification of fuels, calorific values (HCV and LCV), Bomb Calorimeter 7.3 calculation of HCV and LCV using Dulong's formula. 7.4 Proximate analysis of coal and Ultimate Analysis of coal 7.5 solid fuel petrol and diesel - fuel rating (octane and cetane numbers), Chemical composition, calorific values and	**10**	**5**

	7.6 applications of LPG, CNG, water gas, coal gas, producer gas and biogas.		

i. Reference Books:

1. ENGINEERING CHEMISTRY by JAIN & JAIN; DHANPAT RAI
2. A Text Book of Polytechnic Chemistry V.P. Mehta; Jain Brothers
3. A Text Book ofApplied Chemistry. J. Rajaram
4. Engineering Chemistry S S. Dara

a. Course Name: Applied Chemistry Lab

b. Course Code: 03602107

c. Prerequisite: Understanding of Basic knowledge of Science for the application.

d. Rationale: Science is fundamental to technician courses, aiming to cultivate scientific inquiry and cause-and-effect reasoning in students. Chemistry, as applied science, plays a crucial role. Studying chemical concepts like bonding, corrosion, and organic chemistry, along with engineering materials such as polymers and lubricants, enhances understanding of engineering subjects. Chemistry focuses on the changes in matter's structure and properties, forming the basis of engineering processes. Teaching should foster aptitude and predictive skills. A strong science foundation aids students' self-development and adaptability to evolving innovations.

e. Course Learning Objective:

CLOBJ 1	Understand the concept of Existence of material in nature.
CLOBJ 2	Acquainted with the various Mechanism of natural phenomenon.
CLOBJ 3	Explain the characteristic of Material, Substances and Compounds.
CLOBJ 4	Develop skills to do experiments.
CLOBJ 5	Apply analytical techniques to solve the engineering problem and performance analysis of material.

f. Course Learning Outcomes:

CLO 1	Discriminate knowledge of different Chemical reactions.
CLO 2	Understand the different types of titration.
CLO 3	Identify industrially important chemical reations.
CLO 4	Explain the effects of temperature on lubricating oils.
CLO 5	Calculate the hardness in water.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Exam

h. List of Practical/Activities: (To perform minimum 10 Practical)

1. Determine the strength of given acidic solution using standard solution of base
2. Standardize KMnO4 solution by preparing standard oxalic acid and to estimate ferrous ions.
3. Standardize Na2S2O3 solution by preparing standard potassium dichromate and to estimate percentage of copper from brass.
4. Determine the viscosity of given lubricating oil by using Red-wood Viscometer
5. Determine PH-Values of given samples of Solution by using Universal Indicator and PH-meter
6. To Determine molecular weight of a polymer using Ostwald viscometer
7. Preparation of (any one) polystyrene, urea formaldehyde, phenol formaldehyde and its Characterisation.
8. To Determine Acid Value of given lubricating Oil
9. Determine of the percentage of moisture in a given sample of coal by proximate analysis
10. To Determine of saponification value of an lubricating oil
11. Study of corrosion of metals in medium of different Ph
12. To Determine the COD of given water sample
13. Determine Flash & Fire point of given lubricating oil.
14. Study of Corrosion of Metals in the different Mediums.

a. **Course Name:** Introduction to IT Systems Lab

b. **Course Code:** 03606102

c. **Prerequisite:** Basic knowledge of Computer

d. **Rationale:** This course aims to teach students basics of computer including hardware and software.

e. **Course Learning Objective:**

CLOBJ 1	Understand functional units and components of computer
CLOBJ 2	Familiarize the students with basic functions Internet applications.
CLOBJ 3	Enable the students in preparing documents and presentations.
CLOBJ 4	Students can create HTML pages

f. **Course Learning Outcomes:**

CLO 1	Know about different computer components& different types of memory
CLO 2	Create excel sheet, power point, word, access database etc.
CLO 3	Use internet effectively
CLO 4	Create dynamic webpages including style sheet
CLO 5	Comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, create worksheets, prepare presentations, protect information and computers from basic abuses/attacks

g. **Teaching & Examination Scheme:**

h. Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	-	4	2	-	-	100	-	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

i. List of Practical

List of Practical	
1.	Study practical of computer components
2.	Study practical of different OS installation (Windows, Linux, Ubuntu)
3.	Write a script for basic OS commands
4.	Write a script for basic operators in OS
5.	Study practical of Internal structure and components of storage devices(Hard disk components)
6.	Study practical of input working devices (Keyboard, Mouse, scanner)
7.	Study practical of output working devices (Monitor, Printer)
8.	Write a HTML code to display “hello world”
9.	Write a HTML code to create a table for student marksheet.
10.	Write a HTML code to create a simple registration form
11.	Write a CSS to create user define tag
12.	Write an HTML code to create static website using CSS
13.	Study practical of evolution and working of internet
14.	Study practical of surfing techniques in internet
15.	Create your Gmail account and use different services provided by Google like Google drive, sharable sheet etc.
16.	Perform various DOS commands
17.	Develop an excel sheet which has record of 50 students result of 5 subjects and make following analysis 1) Fetch the data of the student who has distinction 2) Fetch the data of students with minimum marks in each subject. 3) Sort the data based on percentage
	Develop an excel sheet which has record of 50 students result of 5 subjects and make following analysis 1) Fetch the data of the student who has distinction 2) Fetch the data of students with minimum marks in each subject. 3) Sort the data based on percentage
18.	Create a presentation of your favorite movie using animation
19.	Create a word file for your resume
20.	Create library management database in access with minimum 5 tables in it.

j. Text Book and Reference Book:

Reference Books	
1.	**Basic Computer Course Made Simple** By Satish Jain | BPB Publication
2.	**Basic Computer Engineering** By Sanjay Silakari and Rajesh K Shukla | Wiley India Pvt. Limited, Pub. Year 2011
3.	**Computer Fundamentals** By P.K. Sinha | BPB Publications
4.	**HTML & CSS: The Complete Reference** By Thomas A. Powell | McGraw Hill

a. Course Name: Engineering Workshop Practice

b. Course Code: 03609154

c. Prerequisite: Learn about fundamental of mechanical and electrical engineering

d. Rationale: Workshop practice is the backbone of the real industrial environment which helps to develop and enhance relevant technical hand skills required by the technician working in the various engineering industries and workshops. This course intends to impart basic know-how of various hand tools and their use in different sections of manufacturing. Irrespective of branch, the use of workshop practices in day to day industrial as well domestic life helps to dissolve the problems. The workshop experiences would help to build the understanding of the complexity of the industrial job, along with time and skills requirements of the job. Workshop curricula build the hands on experiences which would help to learn manufacturing processes and production technology courses in successive semesters. Workshop practice is also important since only practice can make the man perfect

e. Course Learning Objective:

CLOBJ 1	To develop general machining skills in the students.
CLOBJ 2	To develop a skill in dignity of labour, precision, safety at work place, team working and development of right attitude.
CLOBJ 3	The Engineering Workshop Practice for engineers is a training lab course spread over entire semester. The modules include training on different trades like Fitting, Carpentry, Black smithy etc… which makes the students to learn how various joints are made using wood and other metal pieces

f. Course Learning Outcomes:

CLO 1	Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools & equipment's and machines.
CLO 2	Understand job drawing and complete jobs as per specifications in allotted time.
CLO 3	Inspect the job for the desired dimensions and shape.
CLO 4	Operate, control different machines and equipment's adopting safety practices.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	4	2	-	-	100	-	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Text Book and Reference Book:

1. Mechanical workshop practice By K.C. John
2. A Textbook of Electrical Workshop Practices By Dr. Umesh Rathore | S.K. Kataria & Sons
3. A Course in Workshop Technology By Raghuwamsi B S | Dhanpat Rai and Sons, 1682 Nai Darak, New Delhi., Pub. Year 1982
4. Workshop Practice Manual By K. Venkat Reddy | BS Publications
5. Elements of Workshop Technology Vol. I By Hajra Chaudhary S.K. | Asia Publishing House Comprehensive Workshop Techno By S.K. Garg | Laxmi publications

i. List of Experiments:

Exp. No.	Name of the Experiment
1	To A Perform a Job in Carpentry Shop.
2	To A Perform a Job in Tim Smithy.
3	To Perform a Job on Fitting Practice.
4	To Perform a Job on Soldering.
5	To Perform a Job on Welding.
6	To Perform a Job on plumbing.
7	To Perform a Job on Sheet Metal Practice.
8	Identify Different symbol used in electrical installation and prepare sheet.
9	Identify the different tools used in electrical installation.
10	Demonstration of measuring instrument Voltmeter, Ammeter, Wattmeter.
11	Demonstration of testing instruments: Multi meter, Clip-on meter, Megger, Line tester.
12	Demonstration of different cables used in electrical installation.
13	Demonstration of different switches used in electrical installation.
14	Demonstration of protective devices: fuse, MCB, ELCB.
15	Identify different types of domestic wirings.

a. Course Name: Mathematics-II

b. Course Code: 03691151

c. Prerequisite: Knowledge of Basic concept of mathematics studied till first semester

d. Rationale: This course is designed to give a comprehensive coverage at an introductory level to the subject of matrices, Integral Calculus coordinate geometry, Basic elements of vector algebra and First Order Differential Equations.

e. Course Learning Objective:

CLOBJ 1	Understand elementary properties of determinants up to 3rd order, Apply Cramer's rule to solve equations, learn algebra of matrices and matrix inverse method for solving linear equations
CLOBJ 2	Define vectors and their notation, perform vector addition and subtraction, calculate scalar and vector products, solve problems related to work, moment, and angular velocity using vectors.
CLOBJ 3	Determine inclination and slope of a line, Express equations of a straight line in various forms, Understand the general equation of a straight line and conditions for concurrency of lines, Define and work with circles, including equations and properties.
CLOBJ 4	Learn integration as the inverse operation of differentiation, integrate simple functions using various methods, apply definite integrals and understand their properties. Solve problems related to area bounded by curves and volume of solids using integration.
CLOBJ 5	Solve first-order and first-degree differential equations using variable separation method, Work with exact and linear differential equations, gain a simple introduction to MATLAB for solving differential equations.

f. Course Learning Outcomes:

CLO 1	Students will be able to understand the elementary properties of determinants up to 3rd order, consistency of equations, and Cramer's rule. They will also learn the algebra of matrices, inverse of a matrix, and matrix inverse method for solving a system of linear equations in 3 variables.
CLO 2	Students will be able to define and notate vectors, resolve vectors in rectangular form, add and subtract vectors, and calculate scalar and vector products. They will also learn to apply vector algebra to simple problems related to work, moment, and angular velocity.
CLO 3	Students will be able to understand the properties of lines and circles, including slope, intercepts, equations, and conditions for concurrency. They will also learn to calculate equations of chords and tangents for circles
CLO 4	Students will be able to understand integration as the inverse operation of differentiation, integrate simple functions, and apply integration by substitution, by parts, and by partial fractions. They will also learn to solve problems related to area and volume using definite integrals.
CLO 5	Students will be able to solve first-order and first-degree differential equations using variable separation method, exact differential equations, and linear differential equations. They will also gain a simple introduction to MATLAB for solving differential equations.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				T	CE	P	Theory	P	
3	1	0	4	20	20	-	60	-	100

SEE - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

h. Course Content

Course Content

W - Weightage (%) , **T** - Teaching hours

Sr.	Topics	W	T
1	**Unit I: Determinants and Matrices** Elementary properties of determinants up to 3rd order, consistency of equations, Crammer's rule. Algebra of matrices, Inverse of a matrix, matrix inverse method to solve a system of linear equations in 3 variables.	22	8
2	**Unit II: Vector Algebra** Definition notation and rectangular resolution of a vector. Addition and subtraction of vectors. Scalar and vector products of 2 vectors. Simple problems related to work, moment and angular velocity.	13	5
3	**Unit III: Co-Ordinate Geometry** Straight line Inclination and slope of a line, different forms of equations to a straight line , Slope-intercept form , Pointslope form ,Two-point form , Intercept form. General equation of a Straight line, Family of lines. Conditions for concurrency of lines. Circle Definition, Equation of a circle with given center and radius, General form of equation of circle, Equation of a circle when intercepts are given, circle passing through three points, Equation of chord, Equations of tangents and normal at a point on a circle.	15	7
4	**Unit IV: Integral Calculus** Integration as inverse operation of differentiation, Integration of simple functions, Integration by substitution, by parts and by partial fractions (for linear factors only). Definite integral: Definition, Properties of Definite integral, Odd and Even functions, Use of formulas , and for solving problems Where m and n are positive integers. Applications of integration for i. Simple problem on evaluation of area bounded by a curve and axes. ii. Calculation of Volume of a solid formed by revolution of an area about axes. (Simple problems)	37	14
5	**Unit V: Differential Equations** Solution of first order and first degree differential equation by variable separation method (simple problems), Exact differential equations(simple problems), Linear differential equations(simple problems), MATLAB – Simple Introduction.	13	5

i. Text Book and Reference Book:

Reference Books	
1.	**Higher Engineering Mathematics** By B. S. Grewal | Khanna Publications
2.	**Polytechnic Mathematics**

	By S P Deshpande | Pune Vidyarthi Gruh Prakashan

a. **Course Name:** Communication Skills - II

b. **Course Code:** 03693153

c. **Prerequisite:** Knowledge of English Language.

d. **Rationale:** Basic Communication skills are essential for all Diploma Engineers.

e. **Course Learning Objective:**

CLOBJ 1	Develop learning & establish a platform for the students that they can easily learn through various life skills required in the organization for becoming an asset for the organization.
CLOBJ 2	Make them understand how new words are formed, role of syllable, vowel , consonant in pronunciation of word.
CLOBJ 3	Enables students to engage in formal communication as well as to participate in events like debate, extempore etc, and to introduce themto various international Language testing systems
CLOBJ 4	Co-relating of sentence through para jumble concepts.
CLOBJ 5	Encourage students to overcome stage fear through classroom activities.
CLOBJ 6	Make learning fun through the usage of comprehension units.

f. **Course Learning Outcomes:**

CLO 1	Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
CLO 2	Apply and analyses the right kind of pronunciation with regards to speech sounds and able to get different types of pronunciations.
CLO 3	Able to read, understand, and interpret a text intrinsically as well as extrinsically. The learner can browse a text quickly to come-up with a gist and personal interpretation. One is able to create a healthy work-environment and prove to be an asset or one of the most reliable resources to the Organization. As a professional, one is mature to bridge the gulf between the existing behavior/ lifestyle and the expected corporate behaviour cum lifestyle with the help of learning life skills.
CLO 4	Apply the concepts of grammar, various strategies and the usage of formal language in written expression. By using synonyms rewrite the same text in the same format and meaning. Write the gist of the given text.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				T	CE	P	Theory	P	
1	-	-	1	100	-	-	-	-	100

SEE - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

h. Course Content

Course Content

W - Weightage (%) , **T** - Teaching hours

Sr.	Topics	W	T
1	**Listening Skills** Listening Process and Practice - Introduction, importance of good Listening Skills, difference between listening andhearing,types of listening, Barriers to effective Listening, traits of a good listener.	15	6
2	**Listening Skills – Questions** With audio aids, Students will be able to listen to dialogues,improve in gathering information and to summarize the content. To listen and understand day-to-day conversations and to solve questions based on audio files.	10	1
3	**Building Vocabulary** Synonyms, Antonyms, Homophones, Homonyms, Homographs, Phrasal verbs, idioms & phrases, One word substitution.	15	1
4	**Introduction to Phonetics** Sounds: Consonant, Vowel, Diphthongs, transcription of words(IPA) weak forms, syllable division, word stress, intonation and voice.	15	6
5	**Speaking Skill Building Introduction** To enable students to eliminate stage fright and engage in conversation with others.	5	2
6	**Speaking Skill Building Activity** Enables students to engage in formal communication as well as to participate in events like debate, extempore etc, and to introduce them to various international Language testing systems.	5	1
7	**Tourism Pitch** Classroom activity which helps students to express their feelings and experiences in English. Encouraging students to overcome stage fear.	5	1
8	**Lifeboat** Classroom Activity to encourage Communication and Convincing Skills.	5	1
9	**Reporter** Classroom activity to encourage Communication and Convincing Skills.	5	1
10	**Paragraph Jumble** Enhance the skill of writing by completing the paragraph in appropriate and sensible form.	5	4
11	**Life Skills** Self-Awareness, Sympathy, Empathy, Emotional Intelligence.	5	4
12	**Reading Comprehension** A Day's Wait- Ernest Hemingway, My Lost Dollar - Stephen Leacock.	10	2

i. Text Book and Reference Book:

Reference Books	
1.	**Technical Communication : Principles And Practice** By Sangeetha Sharma, Meenakshi Raman | Oxford University Press
2.	**Effective Technical Communication** By Dr. Bharti Kukreja, Dr. Anupama Jain | S.K. Kataria & Sons | 1st
3.	**Active English** By Juneja & Qureshi | Macmillan

SEMESTER 3

a. Course Name: Entrepreneurship and Start-ups

b. Course Code: 03600201

c. Prerequisite: Zeal to Learn the Subject.

d. Rationale: The main objective of this course is to understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation and learning the process and skills of creation. This subject provides detail information about Acquiring Entrepreneurial spirit and resourcefulness, Familiarization with various uses of human resource for earning dignified means of living, Acquiring entrepreneurial quality, competency, and motivation and management of entrepreneurial venture.

e. Course Learning Objective:

CLOBJ 1	Define entrepreneurship and startups, understand the traits of an entrepreneur, and explore the motivation behind starting a business. Identify different types of business structures and analyze the similarities and differences between entrepreneurs and managers.
CLOBJ 2	Discover business ideas, visualize business concepts, and create activity maps. Develop a comprehensive business plan that outlines the vision, goals, and strategies for the startup venture.
CLOBJ 3	Conduct market analysis to identify the target market and evaluate competition. Develop strategies for marketing, accounting, and risk management to ensure the success of the startup.
CLOBJ 4	Understand the importance of company organization structure in startup management. Learn techniques for recruitment and management of talent, as well as financial organization and management.
CLOBJ 5	Explore financing methods available for startups in India and learn to effectively communicate ideas to potential investors through investor pitches. Understand the process of patenting and obtaining licenses to protect intellectual property.
CLOBJ 6	Understand exit strategies for entrepreneurs, including bankruptcy, succession planning, and harvesting strategies. Explore the implications and considerations of each exit strategy.

f. Course Learning Outcomes:

CLO 1	Explain the difference between entrepreneurship and traditional employment.
CLO 2	Describe the concept of a minimum viable product (MVP) and its role in lean start-up methodology.
CLO 3	Apply market research methods to assess the feasibility of a start-up concept.
CLO 4	Evaluate different business models to determine their suitability for specific industries or markets.
CLO 5	Develop a comprehensive marketing plan for a new start-up product or service.
CLO 6	Evaluate the ethical implications of entrepreneurial decisions, such as marketing practices or resource allocation.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	-	-	1	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Unit No.	**Topic**	**Weightage**	**Teaching Hrs.**
1.	**Introduction to Entrepreneurship and Start Ups** Definitions, Traits of an entrepreneur, Entrepreneurship, Motivation, Types of Business Structures, Similarities/differences between entrepreneurs and managers.	20%	06
2.	**Business Ideas and their implementation** Discovering ideas and visualizing the business, Activity map , Business Plan.	15%	04
3.	**Idea to Start-up** Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis	15%	04
4.	**Management** Company's Organization Structure,Recruitment and management of talent, Financial organization and management	20%	04

5.	**Financing and Protection of Ideas** Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses	15%	04
6.	**Exit strategies for entrepreneurs** Bankruptcy, and succession and harvesting strategy	15%	04

i. Text Book and Reference Book:

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company by Steve Blank and Bob Dorf, K & S Ranch
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Busines by Eric Ries, Penguin UK
3. Demand: Creating What People Love Before They Know They Want It by Adrian J. Slywotzky with Karl Weber, Headline Book Publishing
4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business by Clayton M. Christensen, Harvard business

a. Course Name : - Professional Communication and Critical Thinking
b. Course Code: 03693203
c. Prerequisite: Knowledge of English Language
d. Rationale: Advance level of communication and personality development is crucial for and after placement
e. Course Learning Objective:

CLOBJ 1	Develop basic speaking and writing skills including proper use of language & vocabulary so that they become highly confident & skilled speakers & writers
CLOBJ 2	Define the latest trends in basic verbal activities such as presentations, facing interviews & other forms of oral communication.
CLOBJ 3	Engage in professional Development Activities through presentation & enhance communication skills in team.
CLOBJ 4	Enhance non-verbal communication skills such as proper use of body language & gestures.
CLOBJ 5	Identify format & basic to write professionally through emails & reports

f. Course Learning Outcomes:

CLO 1	Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
CLO 2	Be informed of the latest trends in basic verbal activities such as presentations, facing interviews and other forms of oral communication
CLO 3	Develop skills of group presentation and communication in team.
CLO 4	Develop non-verbal communication such as proper use of body language and gestures

g. Teaching & Examination Scheme:

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
1	-	-	-	1	100	100	-	-	-	100

SEE - Semester End Examination, CIA - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

h. Course Content

Course Content **W** - Weightage (%) , **T** - Teaching hours

Sr.	Topics	W(%)	T(h)
1	**Story Mason** Classroom activity to encourage students to speak on topics they are good at, hence boosting confidence of students.	5	1
2	**Determiners, Articles, and Interrogatives** This session will enable students to understand proper usage of Determiners and Articles. It will also enhance their daily speaking conversational/ communication skills. Preparation of verbal section in company's aptitude exam.	10	6
3	**Subject-Verb Agreement** This will enable students to understand the formation of sentence with the usage of subject-verb agreement.	10	3
4	**Reading-Skill Building**Types of Reading – reading for different purposes An Astrologer's Day-Malgudi Days Enhance reading skills by collecting information, know the importance of reading.	10	2
5	**Reading Comprehension** Learn to solve the reading comprehension questions in an easy manner and also in less amount of time Introduction, Factual & Inferential comprehension, Reasons for Poor Comprehension Able to solve reading comprehension in less amount of Time by practicing.	10	2
6	**Mafia the art of Observation and Convincing** The interesting activity is targeted toward improving observation and convincing skills. A team activity in which every single Individual is a very important person of his team to win.	5	1
7	**Direct and Indirect Speech** This session will enable students to understand proper usage of narration.	10	3
8	**Industry Expectation** In this class the students will be made to understand what will be the world after their college life will be, how they should prepare themselves from that competitive world with full of challenges for them.	5	1
9	**Mirror & Water Images** Reflection of an object into a mirror and water. It is obtained by inverting an object laterally (mirror) & vertically (water).	10	3
10	**Sentence Correction** It will also enhance their daily speaking conversational/communication skills. Preparation of verbal section in company's aptitude exam.	5	2

11	**Play Teacher** Classroom activity to encourage students to speak on topics they are good at, hence boosting confidence of students.	**5**	**1**
12	**Professional Writing**Email and report.	**5**	**3**
13	**Group Discussion** It is a systematic exchange of information, views and opinions about a topic, problem, issue or situation among the members of a group who share some common objectives.	**10**	**2**

i. Text Book and Reference Book:

1. Active English By Juneja & Qureshi | Macmillan
2. Verbal and Non-verbal reasoning By B.S.Sijvali and Indu Sijvali | Arihant Publication
3. Competitive English By Azhar Siddiqui | Macmillan

a. Course Name: Basics of Bio Transducers
b. Course Code: 03614205
c. Prerequisite: Understanding Basic knowledge of medical transducer.
d. Rationale: To encourage students to develop understanding of the Biomedical transducers. The expectation of this course is that the students will develop their understanding of the most important biomedical transducers, sensors and instruments.
e. Course Learning Objective:

CLOBJ 1	To understand and explain the fundamental principles and operation of bio transducers, including their types, applications, and the physical and chemical processes they utilize.
CLOBJ 2	Students will also be able to analyze the performance of bio transducers in various biomedical applications and design basic bio transducer systems for real-world problems
CLOBJ 3	Assess the performance parameters of bio transducers, such as sensitivity, accuracy, linearity, and response time, and understand how these parameters influence their applications in biomedical devices.
CLOBJ 4	Identify and describe the different applications of bio transducers in medical diagnostics, monitoring, and therapeutic devices, including examples like ECG, EEG, and biosensors.
CLOBJ 5	Develop basic designs of bio transducers for specific biomedical applications, considering the requirements for signal acquisition, processing, and output.

f. Course Learning Outcomes:

CLO 1	Demonstrate an understanding of the fundamental principles of bio transducers, including their operating mechanisms and classifications.
CLO 2	Analyze and interpret the key performance metrics of bio transducers such as sensitivity, accuracy, and response time, and explain their significance in biomedical applications.
CLO 3	Describe various practical applications of bio transducers in the medical field, such as in diagnostic tools (e.g., ECG, EEG), biosensors, and therapeutic devices.

CLO 4	Apply knowledge of bio transducer principles to design and propose simple bio transducer systems for specific biomedical applications.
CLO 5	Assess the ethical considerations, challenges, and limitations involved in the use of bio transducers, particularly regarding patient safety and data privacy.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage (%)	Teaching Hours
1	**Basics of Biomedical Transducers** Block-diagram of Basic Bio-instrumentation system, Block-diagram of Man-Instrumentation system. Measurement Parameters of Biomedical Instrumentation: Measurement, measurand and transducer. Problems introduced during measuring a living system: such as inaccessibility, variability, lack of knowledge, interaction among various physiological systems, effect of transducer on measurement, artifacts, energy limitation.	**15%**	**8**
2	**Basic Principles of Transducers** Basic transduction principle, Classification of transducers, Types of active transducers: like piezoelectric, thermoelectric, photoelectric. Types of Passive Transducers: resistive transduction, inductive transduction, capacitive transduction. Application of Transducers in biomedical field: piezoelectric, strain gauge. Displacement transducers: LVDT	**25%**	**10**
3	**Electrodes used for measurement of Bio-potential** Main Sources of bioelectric potentials, Electrode theory: Electrode-Electrolyte Interface, Half-cell potential, Types of Gel used for body signal recording. Bio-Potential electrodes: types of electrodes such as body surface electrodes and needle electrodes. Electrodes used for ECG measurement, Electrodes used for EEG measurement, Electrodes used for EMG measurement	**15%**	**10**
4	**Transducers used for cardiovascular measurement** Introduction to cardiovascular measurement and its importance, Blood flow measurement: types of blood flow: Laminar and Turbulent, charecteristics of blood flow. Blood flow measurement techniques: Electromagnetic blood flow meter and Ultrasound blood flow meter. Heart sound measurement: stethoscope, transducer used for heart sound measurement: microphone method.	**20%**	**10**
5	**Transducers used for temperature measurements** Introduction of Temperature transducers, different temperature scale conversion, types of temperature measurement: 1. systemic body temperature: mercury thermometer, thermocouple, thermistor and 2. Skin temperature measurement: infrared thermometer. Transducers used for Respiration rate measurement	**25%**	**10**
	Total	**100 %**	**48**

i. Text books:

1. H.T.Kasipara, Biomedical Transducers (TextBook), Akshat, 2010.
2. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, 2012.
3. J. G. Webster | John Wiley & Sons, N.Y, Medical Instrumentation Application and Design, 2015.

a. Course Name: Basics of Bio Transducers Lab

b. Course Code: 03614206

c. Prerequisite: Basic knowledge of medical transducer.

d. Rationale: The students need to learn fundamentals of Biomedical transducers. The expectation of this course is that the students will develop their understanding of the most important biomedical transducers, sensors and instruments.

e. Course Learning Objective:

CLOBJ 1	Gain hands-on experience with different types of bio transducers, learning how to operate, test, and analyze their functionality in real-world biomedical applications.
CLOBJ 2	Develop and perform experiments that demonstrate the principles of bio transduction, including signal acquisition, amplification, and data interpretation.
CLOBJ 3	Acquire the skills to accurately measure biological signals such as electrical, chemical, and mechanical signals from the body, and convert them into readable electrical outputs.
CLOBJ 4	Learn to evaluate the performance characteristics of bio transducers in a laboratory setting, including their sensitivity, range, and response time, and understand how environmental factors can influence these parameters.

f. Course Learning Outcomes:

CLO 1	Demonstrate the ability to set up and operate various types of bio transducers, accurately measuring biological signals in a laboratory environment.
CLO 2	Develop and execute experiments that showcase the fundamental principles of bio transduction, including the acquisition and processing of biological signals.
CLO 3	Effectively collect, analyze, and interpret data from bio transducers, using appropriate tools and techniques to assess signal quality and system performance.
CLO 4	Assess the performance characteristics of bio transducers, such as sensitivity, linearity, and response time, and understand how these parameters impact the accuracy and reliability of biomedical measurements.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. NO.	Experiment List
1	Identify and rearrange the various blocks of man-instrument system.
2	Measure body temperature using thermocouple.
3	To study about the use of different types of ECG electrodes.
4	To study about the use of different types of EEG electrodes.
5	To study about the use of different types of EMG electrodes.
6	Measure blood pressure using sphygmomanometer and stethoscope.
7	To study about the performance of LVDT.
8	To study about the use of stethoscope to listen heart sound.
9	To study about the use of resistive transducers.
10	To study about the use of capacitive transducers.

a. **Course Name:** Life Science
b. **Course Code:** 03614209
c. **Prerequisite:** Understanding of Basic knowledge of human body structure and their functions.
d. **Rationale:** The course integrates concepts from biology, chemistry, physics, and environmental science, fostering a holistic understanding of how biological systems operate in conjunction with physical and chemical processes.
e. **Course Learning Objective:**

CLOBJ 1	Develop a strong foundation in the terminology used to describe the human body's structure, including directional terms, body planes, and regions.
CLOBJ 2	Gain detailed knowledge of the structure and function of the major body systems, including the skeletal, muscular, nervous, cardiovascular, respiratory, digestive, urinary, endocrine, and reproductive systems.
CLOBJ 3	Understand the cellular structure and function, as well as the organization and function of tissues in the human body, including epithelial, connective, muscle, and nervous tissues.
CLOBJ 4	Explain the concept of homeostasis and analyze how various body systems interact to maintain internal stability in response to external and internal changes.
CLOBJ 5	Demonstrate an understanding of the relationship between anatomical structure and physiological function, explaining how the design of body parts enables their specific functions.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate proficiency in using and understanding anatomical terminology, including the ability to accurately describe the location and function of body parts using appropriate directional terms and body planes.
CLO 2	Accurately identify and describe the structures of the major body systems, including the skeletal, muscular, nervous, cardiovascular, respiratory, digestive, urinary, endocrine, and reproductive systems.
CLO 3	Explain the structure and function of cells, as well as the classification, structure, and function of the four basic tissue types (epithelial, connective, muscle, and nervous tissues) in the human body.
CLO 4	Describe how various body systems contribute to maintaining homeostasis, including how feedback mechanisms work to regulate internal conditions such as temperature, pH, and fluid balance.
CLO 5	Apply anatomical and physiological knowledge to recognize and explain common diseases and disorders, understanding how alterations in structure and function can lead to specific health conditions.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Human Anatomy and Physiology -Cells, Tissue, Blood** Introduction of human anatomy and physiology and the different systems with their structure and functions.	10%	7
2	**Cardiovascular System** Anatomy of heart and Conducting System of Heart, Blood flow through heart, circulatory system-major arteries and major veins. Heart related terms: i) Cardiac cycle ii) Heart Sounds iii) Heart rate iv) Pulse v) Cardiac output vi) Blood pressure (systolic, diastolic and mean arterial pressure) vii) Rhythmicity viii) Contractility ix) Conductivity x) Excitability, Blood circulatory system, Electrocardiogram(ECG) Waveform	15%	9
3	**Digestive, Respiratory System** Introduction of respiratory tract and its organ functions-types of respiratory tract such as upper and lower with basic structural features of lungs, trachea, bronchi, alveoli, Area covered by alveoli, Generations of Respiration: Mechanism of respiration, Principle of gas exchange. i) Internal respiration ii) External respiration. Pulmonary volumes and capacities (Spriogram). Introduction of digestive tract: their structure and functions of digestive organs including basic structural features of esophagus, stomach, liver, pancreas, gall bladder, small intestine, large intestine.	20%	6
4	**Skeletal System** Introduction of individual bones of the skeleton and their main structural features, main types of joints and their	10%	6

	movement in the body, Classification of muscles based on different criteria, Bones-structure and functions, types of bone such as long, short, irregular, flat, sesamoid, structure of long bone, Joints-classification, types of joints, Muscles-classification on the basis of striations, voluntary control and function.		
5	**Excretory System** Excretory system- structure of kidney including microscopic and macroscopic structure, urinary bladder, ureters, micturition process, urethra.	**15%**	**5**
6	**Central Nervous System** Introduction to nervous system CNS, PNS. Central nervous system- various parts of brain such as cerebrum, mid brain, medulla oblongata, cerebellum, spinal cord and internal structure of spinal tract. Peripheral nervous system sensory nerves and motor nerves. Neurons i) Properties of neurons ii) Structural feature of neuron. Synapse i) Classification of synapse. Electroencephalogram (EEG)	**20%**	**7**
7	**Reproductive System** Introduction of Male & Female reproductive system-Basic structural features of testis, ovaries, uterus, fallopian tube.	**10%**	**8**
	Total:	**100 %**	**48**

i. Text Book and Reference Book:

1. Dr.Padma Sanghan, Human anatomy and physiology made easy, Akshat, 2010.
2. Ross and Wilson, Human anatomy and physiology, Ross and Wilson Elsevier, 2010.
3. K. Sembulingam & Prema Sembulingam, Essentials of medical physiology, Jaypee Brothers Medical Publishers, 2019.

a. Course Name: Life Science Lab

b. Course Code: 03614210

c. Prerequisite: Understanding of Basic knowledge of human body structure and their functions.

d. Rationale: The course integrates concepts from biology, chemistry, physics, and environmental science, fostering a holistic understanding of how biological systems operate in conjunction with physical and chemical processes.

e. Course Learning Objective:

CLOBJ 1	Develop the ability to accurately identify and label anatomical structures using models, diagrams, and cadaver specimens, covering major body systems such as the skeletal, muscular, cardiovascular, and nervous systems.
CLOBJ 2	Demonstrate proficiency in using laboratory equipment and techniques, including microscopes, dissection tools, and physiological measurement devices, to explore and analyze human anatomy and physiology.
CLOBJ 3	Relate the anatomical structure of organs and tissues to their physiological functions, demonstrating how specific anatomical features support their roles in maintaining homeostasis and overall body function.
CLOBJ 4	Apply anatomical and physiological knowledge to simulated clinical scenarios or case studies, using lab findings to solve problems and understand potential implications for health and disease.
CLOBJ 5	Understand the relationship between structure and function in various organs and systems.

f. Course Learning Outcomes:

CLO 1	Successfully identify and label anatomical structures using models, diagrams, and cadaver specimens, demonstrating a clear understanding of the major body systems and their components.
CLO 2	Relate anatomical structures to their functions and apply this knowledge to interpret experimental findings and solve problems in simulated clinical scenarios or case studies.
CLO 3	Integrate theoretical knowledge from lecture courses with practical lab experiences, demonstrating an understanding of how anatomical and physiological principles are applied in real-world contexts.
CLO 4	Show proficiency in using laboratory equipment and tools, including microscopes, dissection instruments, and physiological measurement devices, to explore and analyze anatomical and physiological concepts.
CLO 5	Collect, record, and interpret physiological data from experiments (e.g., heart rate, blood pressure, respiratory rate) to assess and understand normal physiological functions and variations.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. NO.	Experiment List
1	Draw the biological cells by observing under microscope.
2	Find out blood group of a sample.
3	Measure blood pressure using sphygmomanometer and stethoscope.
4	Recognize the internal structure of Human heart using heart model.
5	Calculate heart rate using electrocardiogram.
6	Use stethoscope to listen heart sound.
7	Distinguish the various parts of respiratory tract using respiratory model system.
8	Measure lung volumes and capacities using spirometer (spirogram).
9	Identify the various parts of digestive system with the help of digestive model.
10	Identify bones and joints of skeleton using human skeleton model.

SEMESTER 4

a. **Course Name:** Essence of Indian Knowledge and Tradition (Audit Course)

b. **Course Code:** 03600251

c. **Prerequisite:** Zeal to learn Subject

d. **Rationale:** The course aims at imparting basic principles of thought process, reasoning and inference. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature is also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

e. **Course Learning Objectives:**

CLOBJ 1	Analyze the fundamental principles and methodologies of modern science and its role in shaping contemporary society.
CLOBJ 2	Examine key concepts of Indian traditional knowledge systems, such as Ayurveda and yoga, and their historical significance.
CLOBJ 3	Synthesize insights from both modern science and Indian traditional knowledge to develop innovative solutions for contemporary challenges.

f. **Course Learning Outcomes:**

CLO 1	Understanding the role of Modern Science.
CLO 2	Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**T**	**CE**	**P**	**Theory**	**P**	

2	**0**	**0**	**0**	**20**	**20**	**-**	**-**	**-**	**40**

SEE - Semester End Examination, CIA - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

h. Course Content

Sr.	Topics	W	T
1	**Basic Structure of Indian Knowledge System** i) Vedas, (ii) Unveda (Ayurveda, Dhanuveda, Gandhveda, Sthanya etc.) (iii) Vedanga (Education, Kalna, Nanrut, Grammar, Jyotish verses), (iv) Upaayaga (Dharma level, Vivamsa, Purana, Takma level)	60	12
2	**Modern Science and Indian Knowledge System**	15	5
3	**Yoga and Holistic Health care**	15	5
4	**Case Studies**	10	4
	Total	**100 %**	**26**

a. Course Name: Hospital Planning and Clinical Services

b. Course Code: 03614251

c. Prerequisite: Basic knowledge of planning, administrative services, layouts and working of the hospitals.

d. Rationale: To understand the need to create healthcare facilities that are efficient, adaptable, and capable of meeting both current and future healthcare demands. By prioritizing patient care, resource management, technological integration, and regulatory compliance, hospitals can serve as pillars of the healthcare system, providing high-quality services that improve health outcomes for individuals and communities.

e. Course Learning Objective:

CLOBJ 1	Understand the role of hospitals within the broader healthcare system and the interdependence of hospital infrastructure, clinical services, and community health needs.
CLOBJ 2	Develop the ability to perform community health needs assessments and feasibility studies to inform hospital planning and service provision.
CLOBJ 3	Learn the principles of hospital design and layout to enhance patient flow, safety, and operational efficiency.
CLOBJ 4	Gain knowledge of how clinical services are organized and integrated within hospitals, including primary, secondary, and tertiary care services.

CLOBJ 5	Develop skills in budgeting, financial planning, and resource allocation for hospital operations and clinical services.
CLOBJ 6	Understand the legal, regulatory, and accreditation requirements necessary for hospital planning and the provision of clinical services.

f. Course Learning Outcomes:

CLO 1	Students will be able to describe the key components of healthcare systems and explain how hospital infrastructure is designed to meet patient care demands.
CLO 2	Students will be able to analyze demographic, epidemiological, and socio-economic data to determine healthcare service needs and design appropriate hospital services.
CLO 3	Students will be able to apply functional planning concepts to design hospital facilities that optimize space utilization, workflow, and patient experience.
CLO 4	Students will be able to plan, coordinate, and evaluate the integration of various clinical services to ensure comprehensive care delivery.
CLO 5	Students will be able to create financial plans and resource strategies that support sustainable hospital management and service delivery.
CLO 6	Students will be able to identify and adhere to the legal frameworks, health policies, and safety standards governing hospital operations and healthcare delivery.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	**Content**	**Weightage (%)**	**Teaching Hours**
1	**Hospital** Define medical care and a hospital, Role of hospital in health care: Changing role of hospitals, Environmental health services, Health and medical care, Hospital Planning and design: Classification of Hospitals, Different	**15%**	**8**

	guiding principles in hospital planning, Various factors influencing hospital utilization.		
2	**Out/In patient & Nursing Services** Out/In patient: Introduction of outpatient services: Outpatient, Emergency outpatient, referred outpatient, general outpatient, outpatient visit, unit of service & service time. Flowchart of an outpatient department, Common problems in outpatient services. Nursing Services: Various functions and roles of nursing services, Factors influencing the number of nurses.	**20%**	**10**
3	**Intensive Care Unit and Central Sterile Supply Department** Intensive Care Unit: Introduction, Role and functions of an ICU, Types of ICU, Layout of an ICU. Central Sterile Supply Department: Introduction of CSSD, Functions of CSSD, Flowchart of CSSD.	**25%**	**6**
4	**Effective hospital management** Introduction, Principles of hospital management, Various managerial activities of a hospital. Roles and functions of hospital administration, Skills of Effective Managers, Characteristics of Effective Managers.	**20%**	**7**
5	**Administrative services** Introduction, Various functions of medical records, Flowchart of an inpatient record, Material Management: Operative goals of materials management, material management process.	**10%**	**6**
6	**Disposal of Hospital Waste** Define waste, types of waste, characteristics of a good waste disposal system, General classification of waste, Colour coding of containers, Transportation of waste: On-site and Off-site waste, Symbols of Hospital Hazards.	**10%**	**7**
	Total:	**100 %**	**44**

i. Text Book and Reference Book:

1. Hospital Planning and Administration, By Ckewelyn Davis; J.P. Brothers
2. Principles of Hospital Administration and planning (TextBook), By Dr. B.M. Sakharkar; J.P. Brothers

a. **Course Name:** Analytical Instrumentation
b. **Course Code:** 03614255
c. **Prerequisite:** Basic knowledge about to Operate and maintain various analytical instruments.
d. **Rationale:** To understand the knowledge and skills to operate, understand, and apply modern analytical tools essential for advancing research, ensuring product quality, and safeguarding health and the environment.
e. **Course Learning Objective:**

CLOBJ 1	Learn the theoretical principles behind the operation of common analytical instruments such as spectrophotometers, chromatographs, mass spectrometers, and microscopes.
CLOBJ 2	Understand how to apply different analytical techniques for both qualitative and quantitative analysis of substances.
CLOBJ 3	Develop the skills to calibrate and validate analytical instruments to ensure accurate and reliable data.
CLOBJ 4	Learn how to interpret data obtained from analytical instruments and analyze results in a scientific context.
CLOBJ 5	Gain hands-on experience in the operation, troubleshooting, and maintenance of various analytical instruments.
CLOBJ 6	Understand the criteria for selecting the most suitable analytical technique based on the sample type, matrix, and analysis objectives.

f. **Course Learning Outcomes:**

CLO 1	Students will be able to explain the working principles, components, and functions of various analytical instruments used in scientific and industrial applications.
CLO 2	Students will be able to choose appropriate instrumentation techniques to analyze samples, detect impurities, and quantify concentrations of chemical species.
CLO 3	Students will demonstrate the ability to calibrate instruments, interpret calibration data, and validate performance to maintain measurement accuracy.
CLO 4	Students will be able to process and interpret analytical data, identify trends, detect errors, and draw valid conclusions based on instrument outputs.
CLO 5	Students will be proficient in the use of key instruments, perform routine maintenance, and troubleshoot common operational issues to ensure optimal performance.
CLO 6	Students will be able to recommend and justify the use of specific instruments for various analytical tasks based on sample properties and desired outcomes.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction to Analytical Instruments** Block-Diagram of Elements of analytical Instrument, Performance requirements of analytical instruments such as errors in chemical analysis, Accuracy and precision, SNR. Block-Diagram of Intelligent analytical Instrumentation system.	15%	8
2	**Principle of Colorimeters and Spectrophotometers** Electromagnetic radiation: Electromagnetic spectrum, interaction of Radiation with matter. Beer-Lambert's law related to absorption of Radiation. Components of Absorption instruments: different optical filters, monochromators, photosensitive detectors, slit Width, sample holders. Basic Concepts of Colorimeters, Types of Colorimeters: single beam filter photometer and double Beam colorimeter. Basic Concepts of Spectrophotometer, Block-Diagram of spectrophotometer, Applications of Spectrophotometer.	20%	12
3	**Flame Photometer** Introduction of Flame photometry, Principle of Flame Photometry, Block-diagram of Flame Photometer, Applications of Flame Photometer. Constructional details of Flame Photometer, Types of flame photometers: single beam and double beam flame photometer.	20%	10
4	**Blood Gas Analyzers** Introduction to pH, Principle of pH measurement, Blood pH measurement, Electrodes used in Blood pH Measurement: Syringe electrode, Micro-capillary Glass	25%	14

	Electrode, Microelectrode, Miniature pH Glass Electrode. Concept of Blood Gas Analyzer, Use of Blood Gas Analyzer, Acid base balance, Measurement of Blood pCo2, Cell counting methods: Microscopic method, Automatic optical method, Electrical conductivity method, Coulter counters method.		
5	**Gas Chromatography and Sterilizer Equipment** Chromatography: Introduction to Chromatography and Its techniques. Gas chromatograph: parts of gas chromatograph such as carrier gas, detection and recording system. Sterilize Equipment: Autoclave, Biochemistry Analyzer.	**20%**	**8**
	Total:	**100 %**	**52**

i. Text Book and Reference Book:

1. Handbook of Bio-Medical Instrumentation, By R. S. Khandpur; Tata McGraw Hill.
2. Instrumental Methods of Analysis, By Willard, Merritt, Dean, Settle,; CBS Publishers & Distributors, New Delhi, Seventh edition.
3. Principles of Instrumental Analysis, By Skoog, Holler, Nieman Thomson; books-cole publications; 5th edition.
4. Introduction to Instrumental Analysis, By Robert D. Braun; McGraw-Hill Book Company.

a. Course Name: Analytical Instrumentation Lab

b. Course Code: 03614256

c. Prerequisite: Basic knowledge about to effectively operate and maintain various analytical instruments.

d. Rationale: To provide students with practical, hands-on experience in using sophisticated tools and techniques critical to scientific research, industry, and healthcare.

e. Course Learning Objective:

CLOBJ 1	Learn the theoretical principles behind common analytical techniques and how to apply them in practical scenarios.
CLOBJ 2	Learn how to perform precise and accurate measurements using analytical instruments, while understanding the importance of sensitivity and detection limits.
CLOBJ 3	Gain experience in calibrating instruments and validating their performance to ensure accurate analysis.

CLOBJ 4	Learn how to process, analyze, and interpret data obtained from various analytical techniques.

f. Course Learning Outcomes:

CLO 1	Students will be able to explain the working principles of each instrument and apply them to solve real-world problems in areas like chemical analysis, environmental monitoring, and quality control.
CLO 2	Students will be able to collect high-quality data, ensure reproducibility, and assess the reliability of their measurements in various analytical applications.
CLO 3	Students will be able to calibrate instruments, interpret calibration curves, and validate instrument accuracy according to industry standards.
CLO 4	Students will demonstrate the ability to analyze data, recognize patterns, and make informed conclusions based on their results, using statistical and computational tools when necessary.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. NO.	**Name of Experiments**
1	To study about the working principle of single beam photometer.
2	To study about the colometric value of given bio sample with double beam colorimeter.
3	To study about the colometric value of given bio sample with spectrophotometer.
4	To study about the measurement of the pH value of given bio sample with pH meter.
5	To study about Autoclave the given hospital clothes, OT content using the Autoclave.
6	To study about to Calibrate any two instruments for their precision or dismantle and again assemble any two instruments.

7	To study about Flame Photometer.
8	To study about single beam & double beam Flame Photometer.

a. **Course Name:** Biomechanics
b. **Course Code:** 03614257
c. **Prerequisite:** Basic knowledge of physics and Biology is required.
d. **Rationale:** The purpose of this course is to study of the mechanical principles that govern the movement and structure of biological systems, particularly the human body. It combines principles from mechanics, anatomy, and physiology to understand how biological systems respond to forces, enabling improvements in areas like injury prevention, rehabilitation, and performance enhancement.
e. **Course Learning Objective:**

CLOBJ 1	Gain a foundational understanding of key biomechanical principles including forces, moments, stress, strain, and mechanical properties of biological tissues.
CLOBJ 2	Learn to analyze human movement using biomechanical techniques and models.
CLOBJ 3	Apply biomechanical knowledge to evaluate and design ergonomic solutions for workspaces and tools.
CLOBJ 4	Gain insights into the mechanical behavior of muscles, bones, and joints.
CLOBJ 5	Learn to design and conduct biomechanical experiments and research.

f. **Course Learning Outcomes:**

CLO 1	Students will be able to explain basic biomechanical concepts and how they apply to the human body and other biological systems.
CLO 2	Students will be able to perform kinematic and kinetic analyses of human movement, including gait, posture, and sports performance, and interpret the results.
CLO 3	Students will be able to assess ergonomic risks and design modifications to reduce strain and improve efficiency and comfort in various work environments.
CLO 4	Students will be able to describe how different components of the musculoskeletal system interact under various loads and forces, and how these interactions affect movement and stability.
CLO 5	Students will be able to plan, execute, and analyze biomechanical experiments, including data collection using tools such as motion capture systems and force plates.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction of Mechanics** Review of the principles of mechanics, Vector mechanics-Resultant forces of Coplaner & Noncoplaner and Concurrent & non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia.	20%	7
2	**Mechanics of Hard tissue** Structure and functions of Hard Tissues: Bone structure & composition of bone, mechanical properties of bone, cortical and cancellous bones, viscoelastic properties.	10%	7
3	**Mechanics of Soft tissue** Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Material Properties: Cartilage, Tendon, Ligament, and Muscle; Modeling of soft tissues: Cartilage, Tendon, Ligament, and Muscle, Hill's muscle model.	20%	8
4	**Biomechanics of Joints** Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle.	25%	8
5	**Bio-fluid Mechanics & Applied Biomechanics** Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Couette flow and Hagenpoiseuille equation, turbulent flow.Engineering	25%	12

	approaches to standing, sitting and lying, Biomechanics of gait, application of gait and locomotion analysis, Fluid mechanics and energetics: Forms of energy and energy transfer.		
	Total:	**100 %**	**42**

i. Text Book and Reference Book:

1. Biomechanics: Mechanical Properties of Living Tissues- By Y C Fung; Springer; 2nd edition, 1993.
2. Fundamentals of Biomechanics-Equilibrium, Motion and Deformation- By N. Ozkaya and M. Nordin; springer-verlag; 2nd edition, 1999.
3. The Biomedical Engineering Handbook- By Joseph D, Bronzino; CRC Press; 3rd edition, 2006.
4. Biomechanics- Principles and Applications- By D. J. Schneck and J. D. Bronzino; CRC Press; 2nd edition, 2000.

a. Course Name: Microprocessor and Assembly Language

b. Course Code: 03614259

c. Prerequisite: Basic knowledge Knowledge of Fundamental of Digital Electronics.

d. Rationale: This course explores architecture of a microprocessor and its programming in assembly language. The student will be able to apply logics to various given problems and develop programs using assembly language construct that would help them to develop real time microprocessor based application programs.

e. Course Learning Objective:

CLOBJ 1	Learn the internal structure, architecture, and operation of microprocessors, including concepts such as registers, ALU, control unit, and memory addressing modes.
CLOBJ 2	Develop proficiency in writing assembly language programs, including the use of instructions, addressing modes, and data manipulation techniques.
CLOBJ 3	Understand how microprocessors interact with external devices through interfacing techniques such as input/output (I/O) and memory-mapped I/O.
CLOBJ 4	Gain knowledge of the instruction set architecture of microprocessors, understanding various instruction types (data movement, arithmetic, logical, control flow, etc.).
CLOBJ 5	Learn how to implement control flow operations (loops, branches, conditional and unconditional jumps) using assembly language.

f. Course Learning Outcomes:

CLO 1	Students will be able to write, debug, and execute programs in assembly language for specific microprocessors, demonstrating a clear understanding of instruction sets and addressing modes.
CLO 2	Students will demonstrate a solid understanding of the internal architecture of microprocessors, including registers, ALUs, control units, and memory systems.
CLO 3	Students will be able to use various types of instructions (arithmetic, logic, control flow, data transfer) effectively in writing assembly language programs.
CLO 4	Students will gain the ability to design and implement basic microprocessor-based systems by interfacing with external devices, memory, and I/O components.
CLO 5	Students will demonstrate the ability to perform arithmetic operations (add, subtract, multiply, divide) and logical operations (AND, OR, NOT, XOR) using assembly language instructions.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	**Content**	**Weightage (%)**	**Teaching Hours**
1	**Introduction of Microprocessor** Evolution of microprocessor and it's types, Microprocessor Bus organization : Data Bus, Address Bus and Control Bus, Pin diagram of 8085, Architecture of 8085, Internal registers organization of 8085, Limitations of 8085.	**25%**	**14**
2	**Instruction Cycle and Timing Diagram** 8085 machine cycle and bus timings to fetch, decode and execute instruction from memory, Memory read and write , Input/output read and write cycle with timing diagram.	**15%**	**8**
3	**8085 Instruction set**	**25%**	**14**

	Machine language instruction format : Single byte, two byte, three byte Instructions, Various addressing mode, Data transfer operation and instruction, Arithmetic operation and instruction, Logical operation and instruction, Branch operation and instruction, Stack operation and instruction, Input/output and machine control operation and instruction, Simple programs with 8085 instruction.		
4	**Programming Techniques of 8085** Looping, Counting and indexing, Counter and Timing delays, Stack and subroutine basic concepts, Procedure.	**15%**	**8**
5	**Advance Microprocessor and its medical applications** Architecture of 8086, Register organization of 8086, Concepts of Instruction pipelining, Use of microprocessor in medical instrumentation, Interfacing of Human body temperature measurement using microprocessor, Microprocessor based Electrocardiograph (ECG) monitoring system.	**20%**	**10**
	Total:	**100 %**	**54**

i. Text Book and Reference Book:

1. Microprocessor Architecture, Programming and Applications with 8085 (TextBook) - By Gaonkar, Ramesh S.
2. 8085 Microprocessor and its application - By Kani, A. Nagoor; Mc Graw Hill 2013.
3. Microprocessor & Interfacing Programming and hardware Revised second edition- By Hall, Douglas; Tata Mc Graw Hill 2006.

a. Course Name: Microprocessor and Assembly Language Lab

b. Course Code: 03614260

c. Prerequisite: Basic knowledge about Fundamental of Digital Electronics.

d. Rationale: This course explores architecture of a microprocessor and its programming in assembly language. The student will be able to apply logics to various given problems and develop programs using assembly language construct that would help them to develop real time microprocessor based application programs.

e. Course Learning Objective:

CLOBJ 1	Gain hands-on experience in working with microprocessor kits, development boards, or simulators to understand the architecture of microprocessors, including their internal components (ALU, registers, control unit).
CLOBJ 2	Learn to write, debug, and execute assembly language programs on real hardware or simulators, focusing on basic operations, control flow, and data manipulation.

CLOBJ 3	Develop the ability to interface microprocessors with external devices such as sensors, displays, and other I/O devices, using assembly language programming.
CLOBJ 4	Gain proficiency in managing input/output operations, including memory-mapped I/O and programmed I/O, to interact with external devices.
CLOBJ 5	Perform experiments to understand how different types of instructions (arithmetic, logical, control, data transfer) are executed in assembly language.
CLOBJ 6	Learn to use loops, branches, and conditional statements to control the flow of execution in assembly programs.

f. Course Learning Outcomes:

CLO 1	Students will be able to write and execute assembly language programs on microprocessor kits or simulators, demonstrating a solid understanding of instruction sets and microprocessor architecture.
CLO 2	Students will develop the ability to interface microprocessors with peripheral devices (LEDs, keypads, sensors, etc.), and handle basic I/O operations using assembly language.
CLO 3	Students will be able to perform data transfer operations (load, store, move) and data manipulation (arithmetic and logical operations) efficiently using assembly code.
CLO 4	Students will demonstrate the ability to implement control flow structures like loops, jumps, and branches in assembly programs to solve various problems.
CLO 5	Students will gain proficiency in implementing subroutines, using the stack for parameter passing, and managing interrupt-driven operations effectively in microprocessor systems.
CLO 6	Students will acquire skills in debugging assembly language programs using simulators or hardware tools and optimizing their code for performance improvement.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. NO.	Experiment List
1	Demonstrate of kit/simulator of 8085.
2	Implement program to perform arithmetic operations (Add, subtract, multiply and divide) on signed and unsigned two 8 bit numbers.
3	Implement a program to mask the lower four bits of content of the memory location.
4	Implement a program to set higher four bits of content of the memory location to 1.
5	Implement a program to perform Exclusive OR of two numbers.
6	Implement a program to exchange the content of two memory locations.
7	Implement program to add/subtract 16 bit numbers.
8	Implement program to copy content of one memory location to another memory location.
9	Implement a program to check whether given no is odd or even.
10	Implement a program to compare two numbers.
11	Implement a program to sum integers from 0 to 1.
12	Implement a program to count no of zero value in given block of data.
13	Implement program to add an array of data.

a. Course Name: Diagnostic Instrumentation

b. Course Code: 03614261

c. Prerequisite: Basic knowledge about to Operate, calibrate and maintain different diagnostic medical instruments used for sensing various parameters of human body.

d. Rationale: This course will enable the students to understand functioning and constructional features of different diagnostic instruments used in biomedical engineering for sensing various parameters of human body.

e. Course Learning Objective:

CLOBJ 1	Gain a thorough understanding of the principles and concepts behind various diagnostic instruments.
CLOBJ 2	Develop hands-on skills for operating and calibrating diagnostic instruments.
CLOBJ 3	Learn how to interpret and analyze data obtained from diagnostic instruments.
CLOBJ 4	Apply diagnostic instrumentation skills to solve practical problems in medical and industrial contexts.
CLOBJ 5	Learn about quality control and assurance practices related to diagnostic instrumentation.

f. Course Learning Outcomes:

CLO 1	Students will be able to explain the fundamental principles and theories underlying diagnostic tools, including their operational mechanisms and applications.

CLO 2	Students will be able to proficiently operate diagnostic instruments, perform necessary calibrations, and ensure their accurate performance.
CLO 3	Students will be able to analyze and interpret diagnostic data, understand its implications, and make informed decisions based on the results.
CLO 4	Students will be able to use diagnostic tools to address real-world issues, including patient diagnostics and process monitoring.
CLO 5	Students will be able to implement quality control measures, validate instrument performance, and ensure that diagnostic tools meet industry standards and regulatory requirements.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction to Medical Instruments** Introduction to medical instrumentation, Various Sources of biomedical Signals, Basic block diagram of medical instrumentation. Classification of medical instruments based on various principles such as ,Based on diagnostic application, Based on therapeutic application, Based on Imaging application, Based on analytical application, Based on physiological parameter and bio-potential, Based on Biological system and Based on different departments in the hospital.	**15%**	**8**
2	**Biomedical signals** Introduction to Biomedical signals, Introduction to Electrocardiograph, Block diagram of ECG machine, working principle of ECG, 12-lead ECG measurement. Phonocardiography: Introduction of PCG, Origin of sound. Introduction to Electroencephalograph, 10-20 electrode	**25%**	**10**

	placement system, Block diagram of EEG machine. Introduction to Electromyography, Block diagram of EMG machine.		
3	**Patient Monitoring Devices** Heart rate measurement Techniques: Average calculation, Beat-to-Beat calculation and combination of both. Block-Diagram of Average heart rate meter, Block-Diagram of Instantaneous heart rate meter. Pulse rate Measurement Techniques: Electrical, Mechanical and Optical Methods, Concept of Oxygen Saturation measurement (Oximetry), Types of Oximeter: Finger tip pulse oximeter and Ear oximeter.Blood Pressure measurement Techniques: Direct method, Indirect method. Introduction to Respiration rate, Measurement of respiration rate Techniques: Displacement method,Thermistor Method, Impedance pneumography method. Introduction of Apnoea, Block-Diagram of Apnoea Monitor.	**30%**	**12**
4	**Pulmonary Function Test Analyzer** Introduction to Pulmonary function test, Spirogram, various Lung volumes and capacities Spirometry:Types of Spirometer such as Basics Spirometer & Wedge Spirometer.	**15%**	**8**
5	**Audiometers and Hearing Aids** Air & bone conduction, Hearing transducers, Types of audiometers, Hearing aid: Conventional and Digital.	**15%**	**5**
	Total:	**100 %**	**43**

i. Text Book and Reference Book:

1. Biomedical Instrumentation and Measurement - By Carr Joseph J. and Brown John M; Pearson.
2. Handbook of Bio-Medical Instrumentation- By R. S. Khandpur; Tata McGraw Hill.
3. Medical Instrumentation Application & Design- By John G. Webster; Haughton Mifflin, Co. Boston. USA.
4. Biomedical Instrumentation and Measurements- By Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer.

a. Course Name: Diagnostic Instrumentation Lab

b. Course Code: 03614262

c. **Prerequisite:** Basic knowledge about to Operate, calibrate and maintain different diagnostic medical instruments used for sensing various parameters of human body.
d. **Rationale:** This course will enable the students to understand functioning and constructional features of different diagnostic instruments used in biomedical engineering for sensing various parameters of human body.
e. **Course Learning Objective:**

CLOBJ 1	Gain a thorough understanding of the principles, functioning, and applications of diagnostic instruments used in medical, industrial, and laboratory settings.
CLOBJ 2	Develop practical skills in using various sensors and transducers to measure physical, chemical, and biological parameters.
CLOBJ 3	Learn to apply signal processing techniques such as amplification, filtering, and noise reduction to improve data quality from diagnostic instruments.
CLOBJ 4	Understand how to acquire, record, and analyze data from diagnostic equipment using appropriate software.
CLOBJ 5	Gain knowledge on how to calibrate diagnostic instruments to ensure precision, accuracy, and reliability in measurements.
CLOBJ 6	Understand the process of integrating sensors, signal processing units, and data acquisition systems into a cohesive diagnostic setup.

f. **Course Learning Outcomes:**

CLO 1	Students will be able to set up, operate, and troubleshoot various diagnostic instruments, ensuring they function properly and meet the required standards.
CLO 2	Demonstrate the ability to select, configure, and apply sensors and transducers in measuring specific parameters, and integrate them into diagnostic systems.
CLO 3	Students will be able to process and condition signals from diagnostic systems to optimize the quality and accuracy of data obtained from measurements.
CLO 4	Students will be proficient in acquiring, analyzing, and interpreting data using software tools, and they will demonstrate an ability to derive conclusions based on the data.
CLO 5	Students will demonstrate the ability to calibrate diagnostic instruments, ensuring that measurements are precise, repeatable, and in compliance with regulatory standards.
CLO 6	Students will gain the ability to design and implement diagnostic instrumentation systems, selecting appropriate components and ensuring they work cohesively.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. NO.	Experiment List
1	To study about the performance of ECG machine.
2	To study about the different types of leads used in ECG machine.
3	To study about the performance of the EEG machine.
4	To study about the performance of the EMG machine.
5	To study about the measurement of blood pressure using sphygmomanometer and stethoscope.
6	To study about the measurement of SpO2 using pulse oximeter.
7	To study about the performance of audiometer.
8	To study about the measurement of body temperature using digital thermometer.
9	To study about the measurement of heart sound using PCG.
10	To study about the performance of spirometer.

a. Course Name: Minor Project

b. Course Code: 03614266

c. Prerequisite: Basics knowledge in literature review, research methodologies, and data analysis, as they are crucial for project planning and execution.

d. Rationale: This course is to provide students with hands-on experience in working with tools, software, and equipment related to their field of study. This practical exposure is essential for developing problem-solving skills and technical expertise.

e. Course Learning Objective:

CLOBJ 1	Apply the concepts, theories, and principles learned in previous coursework to a practical, real-world problem or challenge.
CLOBJ 2	Enhance the ability to identify, define, and solve technical problems using innovative and analytical approaches.
CLOBJ 3	Develop research skills to investigate existing solutions, technologies, and methodologies, and apply this knowledge to the project.

CLOBJ 4	Gain experience in designing, developing, and implementing a solution or prototype related to the chosen project topic.
CLOBJ 5	Learn project management skills such as project planning, task scheduling, resource allocation, and risk management.
CLOBJ 6	Develop the ability to work effectively in a team, collaborating with peers to achieve a common project goal, and managing group dynamics.

f. Course Learning Outcomes:

CLO 1	Students will demonstrate the ability to apply theoretical knowledge from their academic courses to solve real-world problems effectively.
CLO 2	Students will be able to design and implement a functional system, prototype, or solution that meets the specified project objectives and constraints.
CLO 3	Students will showcase their ability to identify key challenges in their project, apply analytical methods, and propose innovative solutions.
CLO 4	Students will conduct thorough research on the project's subject matter, analyze existing technologies or solutions, and apply them appropriately to the project.
CLO 5	Students will demonstrate the ability to work effectively in a team, manage tasks collaboratively, and contribute to the successful completion of the project.
CLO 6	Students will gain experience in managing a project from inception to completion, including planning, scheduling, resource management, and addressing risks or challenges.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

a. Course Name: Employability Skills

b. Course Code: 03693251

c. Prerequisite: Inclination to learn the importance of critical thinking & Interview Skills.

d. Rationale: Cracking aptitude is the first step towards cracking placements and competitive exams

e. Course Learning Objective:

CLOBJ 1	Improve their critical thinking
CLOBJ 2	Prepares them for Campus Placement & Competitive Exams.
CLOBJ 3	Builds up their confidence level
CLOBJ 4	Understanding ways to present the points in Group Discussions & how it plays an important role in cracking interviews.(selection process)
CLOBJ 5	Learning Entrepreneur skills which promotes them to learn selling techniques.
CLOBJ 6	Grasping the knowledge for preparing resume.

f. Course Learning Outcomes:

CLO 1	Application of the knowledge learnt in resume building
CLO 2	Building confidence & cracking interviews.
CLO 3	Improve competency in Competitive exams through various topics learnt
CLO 4	Selling skills are focused helping them to become an entrepreneur in future.

g. Teaching & Examination Scheme:

Teaching Scheme			**Credit**	**Examination Scheme**					**Total**
				External		**Internal**			
L	**T**	**P**		**T**	**P**	**T**	**CE**	**P**	
2	0	-	0	-	-	-	100	-	100

Lect- Lecture, **Tut** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** – Continuous Evaluation

Note: 15 Hours of additional sessions will be taken (within the semester) to match up 30 hours content.

h. Course Content:

Sr.	Topic	Weightage	Teaching Hrs.
1	**Critical Thinking -Case Studies:** Critical thinking is based on pure logical thinking. Solving a critical reasoning question requires nothing but reasoning ability of the candidate. This session deals with the basic logic involved in critical reasoning questions and covers all the type of questions in CT. Worksheets would be provided to students for further practice.	10%	6
2	**Coding & decoding, Alphabetical Series** Understand various types of questions which they can come across in the given topic. Tips and tricks to solve questions on the above mentioned topics.	8%	4
3	**Analogy and odd man out** Understand various types of questions which they can come across in the given topic. Tips and tricks to solve questions on the above mentioned topics.	8%	4
4	**Direction sense** : Able to solve all the direction sense question in competitive exams and aptitude exams of different companies	8%	4
5	**Blood relations**: Able to solve all the Blood Relation questions in competitive exams and aptitude exams of different companies	8%	4
6	**Paper Folding** In this section of non verbal reasoning a figure is obtained by folding a piece of paper containing same design along the dotted line.	4%	2
7	**Seating Arrangement** Candidates are required to arrange the objects either in a row or circle on the basis of information given Questions are presented in distorted form to create confusion and to taste the candidate's ability to analyze the information step by step in order to answer the question	3%	2
8	**Completion of Figure** In each of the following figure, a part of figure is missing. Find out from the given options, the right figure to fit in the missing figure	3%	2
9	**Completion of Series** In these questions a series of figures is given as problem figure & the candidate are asked to select one of the figure from the set	8%	4

	of answer figure which will continue the given sequence.		
10	**Entrepreneurship skills (SELLING THE CONCEPT):** This topic will help students develop the skills necessary to develop into Self- Sufficient business leaders through Entrepreneurship studies.	4%	2
11	**Resume Building** The students will have a proper understanding of the content and how it is to be presented in resume	8%	4
12	**Group Discussion** It is a systematic exchange of information, views and opinions about a topic, problem, issue or situation among the members of a group who share some common objectives.	14%	8
13	**Interview Skills** Students are prepared for their interviews, question and answers, how to react on some unique questions, body language & grooming is taken into account.	14%	8
	Total	100	60

Continuous Evaluation:

It consists of

1. Phase I Exam-35 Marks(Hybrid or Offline Mode)
2. Phase II Exam -35 Marks (Hybrid or Offline Mode)
3. Activities – (Listening and Speaking) -10+10=20 Marks
4. Attendance -10 Marks

The passing marks for Continous Evaluation will be 40 out of 100.There will not be any re-test.

i. Text Book and Reference Book:

1. Verbal & Non-Verbal Reasoning, Indu Sijwali & B.S. Sijwali
2. Contributor Personality Development by i-become
3. Critical Thinking Skills for Engineers

SEMESTER 5

a. **Course Name:** Medical Imaging Techniques
b. **Course Code:** 03614301
c. **Prerequisite:** Basic knowledge about to maintain different types of medical imaging instruments.
d. **Rationale:** This course will enable the students to understand functioning and constructional features of different imaging instruments used in biomedical engineering for imaging various parameters of human body.
e. **Course Learning Objective:**

CLOBJ 1	Gain a thorough understanding of different medical imaging techniques, including X-ray, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, and nuclear medicine.
CLOBJ 2	Learn the underlying principles and physics of each imaging modality, including the interactions of electromagnetic radiation, sound waves, or radioactive tracers with body tissues.
CLOBJ 3	Understand the clinical applications and indications for each imaging technique, including their strengths, limitations, and specific use cases in diagnosing various medical conditions.
CLOBJ 4	Develop skills in acquiring high-quality images and interpreting them accurately to identify normal and pathological conditions.
CLOBJ 5	Learn about safety protocols, including radiation safety, contrast agent usage, and patient preparation to ensure effective and safe imaging procedures.

f. **Course Learning Outcomes:**

CLO 1	Students will demonstrate a comprehensive understanding of various medical imaging modalities, including their operational principles, advantages, and limitations.
CLO 2	Students will be able to apply appropriate imaging techniques for different clinical scenarios, selecting the most suitable modality based on diagnostic requirements.
CLO 3	Students will be able to acquire high-quality images using different imaging systems, ensuring optimal image quality for accurate diagnosis.
CLO 4	Students will demonstrate the ability to interpret medical images accurately, identifying normal anatomical structures and pathological conditions.
CLO 5	Students will understand and apply safety protocols for imaging procedures, including radiation safety practices and proper handling of contrast agents.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Fundamentals of X-ray Equipment** Electromagnetic radiation, Properties of X-rays, Interactions between X-rays and matter: coherent scattering, photoelectric effect, Compton scattering, Pair production and Photodisintegration. X-ray Generation: White and characteristic radiation, X-ray Generators: Line focus principle, Factors affecting X-ray emission spectrum. Construction of X-rays: Filters, Beam restrictors, Grids, Intensifying screen (Fluorescent screen), Image intensifier, X-ray Receptors: X-ray Film and Radiation Detectors, Construction of stationary anode X-ray tube, X-RAY machine: Block diagram.	25%	12
2	**Diagnostic methods of X -ray** Conventional X-ray radiography with its basic components, Fluoroscopy, Angiography, and Mammography: Mammographic Equipment, Attenuation of imaging techniques, Biological effects of ionizing radiation: Threshold, Exposure time, Exposure area, variations in species and individual sensitivity, variations in cells sensitivity, Short term and Long term effects.	25%	8
3	**CATH-LAB** Introduction of CATH-LAB, Typical instrumentation layout in a Catheterization laboratory, Instruments used in CATH-LAB: Stent catheter, C-Arm machine, Guide wire, Angioplasty balloon, cutting balloon, IATV- Black Panel Detector etc., Pressure waveforms associated with catheterization procedure.	10%	6

4	**Computed Tomography & Magnetic Resonance Imaging Techniques** Computed tomography: Basic Principle of CT, CT number, Generations of CT- Scanner, Windowing scanning techniques, CT Artefacts. Magnetic Resonance Imaging: Principle of NMR and Block-diagram of MRI Machine, Generation and detection of NMR signal: Introduction, types of magnets, NMR coils, transmitter and receiver. Parameters: Angular momentum, Magnetic dipole moment, magnetization, Larmor frequency, free induction decay, Relaxation time.	**20%**	**10**
5	**Ultrasound Imaging** Introduction of USG, Properties of ultrasound, Generation and Detection of Ultrasound: Piezoelectric effect, Construction of Ultrasonic transducer, Pulse- echo technique: Block-diagram of Pulse echo system, Ultrasound imaging methods: A-scan, B-scan, C-scan, M-scan, Doppler method: Continuous wave Doppler method and Pulsed wave Doppler method.	**20%**	**12**
	Total:	**100 %**	**48**

i. Text Book and Reference Book:

1. Hand Book of Biomedical Instrumentation. Tata McGraw Hill. - By R.S. Khandpur.
2. Medical Instrumentation. Application and Design - By John Webster; John Wiley and Sons Inc.
3. Fundamentals of medical imaging - By Paul suetens; Cambridge university press.

a. Course Name: Medical Imaging Techniques Lab

b. Course Code: 03614302

c. Prerequisite: Basic understanding of human anatomy to interpret images accurately and recognize anatomical structures.

d. Rationale: This course will provide students with practical experience in operating imaging equipment and acquiring real images, complementing theoretical knowledge.

e. Course Learning Objective:

CLOBJ 1	Demonstrate knowledge of various medical imaging techniques, including X-ray, MRI, CT, ultrasound, and nuclear medicine.
CLOBJ 2	Acquire hands-on experience in operating imaging equipment and understanding the protocols for different imaging procedures.

CLOBJ 3	Develop the ability to analyze and interpret medical images, recognizing normal and abnormal anatomical structures.
CLOBJ 4	Understand and apply safety protocols and regulations related to radiation exposure and patient care in medical imaging.
CLOBJ 5	Identify and troubleshoot common technical issues encountered in medical imaging.
CLOBJ 6	Collaborate effectively with peers and healthcare professionals to improve patient outcomes through imaging techniques.

f. Course Learning Outcomes:

CLO 1	Demonstrate the ability to perform and operate various medical imaging modalities, including X-ray, MRI, CT, and ultrasound, with confidence and accuracy.
CLO 2	Analyze and interpret medical images to identify normal and pathological findings, utilizing critical thinking and clinical judgment.
CLO 3	Apply safety protocols and best practices to minimize radiation exposure and ensure patient safety during imaging procedures.
CLO 4	Troubleshoot and resolve common technical issues related to imaging equipment and software, ensuring optimal performance.
CLO 5	Work effectively in interdisciplinary teams, communicating imaging findings and collaborating on patient care strategies.
CLO 6	Recognize and adhere to ethical guidelines and patient confidentiality standards in medical imaging practices.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. No.	**Experiment List**
1	To study about the Front Panel of X-ray machine.
2	To study about the Image intensifier & its effect of varying the MAS, and KVp values on

	display film in X ray.
3	To study about Computed Tomography (CT-Scan) Machine.
4	To study about the Generations of CT-Scan Machine.
5	To study about various procedures done in Cath lab (Angiography and Angioplasty).
6	To Study about Magnetic Resonance Imaging (MRI) in Hospital Diagnostic Centre.
7	To Study about the Ultrasound Imaging.
8	To Study about the different modes of Ultrasound.
9	To Study about the Biological effects of Ultrasound.
10	To Study about the identification of various areas of Cath-Lab in Hospital.

a. **Course Name:** Life Threatening Instrumentation
b. **Course Code:** 03614303
c. **Prerequisite:** Basic knowledge about to Operate, calibrate and maintain different Life threatening instruments used in OT, ICCU, ICU and NICU.
d. **Rationale:** This course will emphasizes the importance of equipping healthcare professionals with the necessary knowledge and skills to effectively utilize life-threatening instrumentation in critical care settings.
e. **Course Learning Objective:**

CLOBJ 1	Describe the principles and functionalities of various life-threatening medical instruments used in emergency and critical care settings.
CLOBJ 2	Demonstrate the ability to operate and maintain essential life-threatening instrumentation safely and effectively.
CLOBJ 3	Analyze clinical scenarios to make informed decisions regarding the selection and application of instrumentation in life-threatening situations.
CLOBJ 4	Identify and apply safety standards and protocols to minimize risks associated with the use of medical devices in emergencies.
CLOBJ 5	Evaluate ethical issues related to the use of life-threatening instrumentation in patient care.

f. **Course Learning Outcomes:**

CLO 1	Successfully operate and troubleshoot various life-threatening medical instruments, demonstrating competency in clinical settings.
CLO 2	Interpret clinical data and imaging related to life-threatening conditions, integrating this information into decision-making processes.
CLO 3	Adhere to established safety protocols and guidelines, ensuring patient and staff safety during the use of medical instrumentation.
CLO 4	Recognize and address ethical dilemmas related to instrumentation use, understanding the implications for patient care and decision-making.

CLO 5	Exhibit strong communication skills when discussing instrumentation and patient conditions with interdisciplinary teams.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction of Life-threatening Instrumentation** Introduction- to life threatening instrumentation with enlisting different equipments used in critical units of the hospital. Basic concepts of NICU, Different types of equipments used in NICU, Basic concepts of ICU, Different types of equipments used in ICU, Basic concepts of ICCU, Different types of equipments used in ICCU.	10%	5
2	**Patient monitoring system** Concepts of patient monitoring system, classification of bed side monitoring system, Block-Diagram of Bed side monitoring system, Principle of central monitoring system, classification of central monitoring system. Basic concepts of cardiac monitor & selection of system parameters.	10%	6
3	**Cardiac Defibrillator** Defibrillator, Need for Defibrillator, Types of Defibrillation, Working of DC. defibrillator, types of waveforms, Defibrillator electrodes, Block-diagram of DC- defibrillator with synchronizer, types of defibrillator based on mode of application i.e. AED and implantable defibrillators.	15%	8
4	**Cardiac Pacemaker** Introduction of cardiac arrhythmias, types of arrhythmias, Ventricular fibrillation, need of cardiac pacemaker, types of	20%	8

	pacemakers: External pacemaker & Internal (Implantable) pacemaker, Classification of codes for Pacemaker, Block diagram of ventricular synchronous demand type pacemaker, Basic Components of Pacemaker, Types of Leads and Electrodes, Problems with leads and Electrodes.		
5	**Life Support Equipment** Mechanism of respiration, artificial ventilation, Positive Pressure ventilator, types of ventilators, Ventilator terms: lung compliance, mean airway pressure, inspiratory pause time, tidal volume, minute volume, conventional mechanical ventilation, positive end expiratory pressure(PEEP), Classification of ventilators, Modern ventilators: Microprocessor based ventilator, ventilator modes-such as spontaneous and mandatory ventilation. Principle of other life support equipment: Oxygenator, heart lung machine, nebulizer, intra-aortic balloon pump, Anesthesia machine: gas supply and delivery, vapor delivery, patient breathing circuit.	**25%**	**10**
6	**Telemetry system** Introduction of telemetry - wireless telemetry, techniques of modulation, transmitter and receiver, types of telemetry: single channel telemetry, multichannel telemetry and respiration based telemetry, Blood flow based implantable telemetry system and blood pressure based implantable telemetry system.	**20%**	**6**
	Total:	**100 %**	**43**

i. Text Book and Reference Book:

1. Hand Book of Biomedical Instrumentation. Tata McGraw Hill. - By R.S. Khandpur.
2. Medical Instrumentation. Application and Design - By John Webster; John Wiley and Sons Inc.
3. Biomedical Instrumentation and Measurements - By Leslie Cromwell.
4. Introduction to Biomedical Equipment Technology- By Carr & Brown; Pearson Education, Asia.

a. Course Name: Life Threatening Instrumentation Lab

b. Course Code: 03614304

c. Prerequisite: Basic understanding of physics related to the functioning of medical devices, particularly in critical care settings.

d. **Rationale:** This course combines theoretical knowledge with practical applications, providing hands-on experience that prepares students for real-life scenarios in emergency and critical care settings.

e. **Course Learning Objective:**

CLOBJ 1	Develop practical skills in operating life-threatening medical instruments commonly used in emergency and critical care settings.
CLOBJ 2	Understand and implement safety procedures to ensure the safe use of medical devices and protect both patients and healthcare providers.
CLOBJ 3	Identify and resolve common technical issues encountered with life-threatening instrumentation.
CLOBJ 4	Apply theoretical knowledge to real-world scenarios, demonstrating the ability to make informed decisions during emergencies.
CLOBJ 5	Enhance teamwork skills by participating in group simulations and collaborative exercises focused on critical care situations.
CLOBJ 6	Discuss ethical issues related to the use of life-threatening instrumentation and develop a framework for ethical decision-making in clinical practice.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate proficiency in the operation and maintenance of various life-threatening medical instruments, ensuring effective and safe use.
CLO 2	Successfully identify and apply safety protocols, minimizing risks associated with medical device usage in emergencies.
CLO 3	Exhibit the ability to troubleshoot and resolve technical issues with instrumentation during lab exercises.
CLO 4	Analyze clinical scenarios effectively, applying learned skills to make appropriate decisions in high-pressure situations.
CLO 5	Communicate clearly and effectively with peers and instructors during collaborative simulations, fostering a supportive learning environment.
CLO 6	Demonstrate an understanding of ethical considerations in the use of life-threatening instrumentation, applying this knowledge in practical scenarios.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	

-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. No.	Experiment List
1	To study about various instruments used in critical care unit.
2	To study about to identify various parameters of bed side monitor.
3	To study about the various electrodes used in defibrillator.
4	To study about the Principle of DC-Defibrillator.
5	To study about the DC-Defibrillator with Synchronizer.
6	To study about External & Internal Pacemaker.
7	To study about different sections of Heart Lung Machine.
8	To study about to identify the different sections of ventilator and operate it in different modes.
9	To study about to identify different controls of bubble oxygenator.
10	To study about to identify the different sections of nebulizer and maintain them.

a. Course Name: Therapeutic Instrumentation

b. Course Code: 03614305

c. Prerequisite: Basic knowledge about to maintain different types of therapeutic instruments.

d. Rationale: This course will provide knowledge of principle and constructional features of various therapeutic equipments. The course will also deal with different advance therapeutic technology.

e. Course Learning Objective:

CLOBJ 1	Learn the foundational concepts of biomedical instrumentation, focusing on therapeutic devices.
CLOBJ 2	Understand the function and applications of devices such as ventilators, defibrillators, infusion pumps, and laser therapy machines.
CLOBJ 3	Learn how therapeutic instruments are designed, tested, and calibrated to ensure effective and safe operation.
CLOBJ 4	Understand the importance of patient safety and how to mitigate risks when operating therapeutic equipment.
CLOBJ 5	Develop the skills needed to troubleshoot common issues and ensure the accurate function of therapeutic instruments.

f. Course Learning Outcomes:

CLO 1	Explain the basic principles of therapeutic instrumentation and the science behind the therapeutic modalities used in various medical procedures.
CLO 2	Identify and describe key therapeutic devices used in clinical settings, including their functionality, applications, and limitations.
CLO 3	Demonstrate practical knowledge of therapeutic instrumentation through hands-on experience and laboratory work.
CLO 4	Analyze the performance of therapeutic devices and understand how to interpret their data for improving treatment outcomes.
CLO 5	Ensure compliance with safety standards and regulations while using therapeutic devices to ensure patient safety and device efficacy.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	**Content**	**Weightage (%)**	**Teaching Hours**
1	**Introduction of LASER** Introduction to therapeutic instrumentation, Introduction of LASER, Principle Operation of LASER, Main elements of LASER. classes of LASER, Types of LASER: Helium-Neon LASER, Various applications of LASER in Biomedical field.	**10%**	**5**
2	**Electrotherapy and Physiotherapy Instruments** Introduction of Electrotherapy and Physiotherapy, Parameters of Electrotherapy and Physiotherapy related instruments like shift & timing of waveform, Electrotherapy: including different types of waveforms such as galvanic current, faradic current, surging current, exponentially progressive current, biphasic stimulation, Interferential Current Therapy (IFT),	**25%**	**8**

	Pain relief through electric stimulation: Transcutaneous Electrical Nerve Stimulator (TENS) Physiotherapy: High frequency heat therapy, Short wave Diathermy, Circuit Diagram of Short wave Diathermy, Application techniques used in Short wave Diathermy: Capacitive method and Inductive method, Ultrasonic Therapy Unit, Block-Diagram of Ultrasonic Therapy Unit.		
3	**Dialysis Machine** Function of Kidneys, Artificial Kidney, Principle of Dialysis in the Artificial Kidney, Dialyzers, types of Dialyzers: such as parallel flow, coil, hollow fiber, Schematic Diagram of Dialysis Machine.	**20%**	**6**
4	**Automatic Drug Delivery System** Introduction of Automatic Drug Delivery System, Infusion pumps and its applications, Components of Drugs infusion systems, Delivering of Drug, types & Principles of Infusion Pumps: Syringe pumps and Peristaltic Pumps.	**10%**	**6**
5	**Surgical Diathermy** Introduction of Surgical diathermy, Principle of Surgical Diathermy, techniques or modes of Surgical Diathermy - cutting, coagulation, fulguration, desiccation, homeostasis, Difference between Spark gap oscillator and solid state oscillator, Construction and working of Solid state Electrosurgical Unit (ESU), types of Electrodes used in cutting and coagulation, safety aspects in Electrosurgical Unit.	**20%**	**8**
6	**Incubator and Radiant Warmer** Introduction of Incubator, Principle of Incubator, Important parameters of Incubator, temperature controlled infant incubator: Block diagram of temperature controlled infant incubator, Parts of an Infant incubator, Types of Infant incubator, Physiological Heat balance: heat loss and heat production methods, Phototherapy Unit. Radiant Warmer: Working principle of Radiant warmer, Modes of radiant warmer, Parts of radiant warmer.	**15%**	**10**
	Total:	**100 %**	**43**

i. Text Book and Reference Book:

1. Hand Book of Biomedical Instrumentation. Tata McGraw Hill. - By R.S. Khandpur.

2. Medical Instrumentation. Application and Design - By John Webster; John Wiley and Sons Inc.

a. **Course Name:** Therapeutic Instrumentation Lab
b. **Course Code:** 03614306
c. **Prerequisite:** Basic Familiarity with the structure and function of the human body, especially in relation to how therapeutic devices interact with biological tissues.
d. **Rationale:** This course helps students learn how to assess the performance of therapeutic instruments, including analyzing output data, understanding device efficacy, and applying feedback to improve clinical outcomes.
e. **Course Learning Objective:**

CLOBJ 1	Gain a practical understanding of how various therapeutic instruments work, including their components, operation, and clinical applications.
CLOBJ 2	Learn to correctly handle, operate, and calibrate therapeutic instruments such as ventilators, electrotherapy units, infusion pumps, and other devices used in clinical settings.
CLOBJ 3	Apply safety protocols and follow regulatory guidelines while using therapeutic equipment to minimize risks to patients and healthcare personnel.
CLOBJ 4	Learn how to collect, interpret, and analyze data produced by therapeutic devices, such as monitoring treatment parameters, device efficacy, and patient response.
CLOBJ 5	Gain the ability to diagnose and troubleshoot common issues with therapeutic instruments, ensuring their proper maintenance and optimal functioning.
CLOBJ 6	Integrate theoretical knowledge of therapeutic instrumentation with practical applications to solve real-world healthcare problems.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate the ability to safely and effectively operate various therapeutic devices used in clinical treatments, including calibrating and adjusting devices as needed.
CLO 2	Evaluate the functionality and performance of therapeutic devices, ensuring they are working within specified parameters and meeting clinical requirements.
CLO 3	Apply safety standards and follow the necessary protocols while using therapeutic equipment to ensure patient and operator safety.
CLO 4	Identify and solve common technical issues or malfunctions in therapeutic devices, using systematic troubleshooting techniques.
CLO 5	Accurately interpret data from therapeutic devices, assess patient responses, and make informed decisions about the effectiveness of the treatment.

CLO 6	Demonstrate an understanding of the clinical applications of therapeutic instruments in healthcare settings, including how they are used to treat specific conditions.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	30	-	20	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. No.	Experiment List
1	To study about short wave diathermy in condenser/ inductive fields.
2	To study about Ultrasonic therapy unit.
3	To study about nerve stimulation using TENS.
4	To study about nerve stimulation using IFT.
5	To study about various applications of infusion pump in hospitals and observe their operation.
6	To study about working of neonatal incubator.
7	To study about working principle of Helium-Neon laser.
8	To study about working of artificial kidney.
9	To study about Principle of surgical diathermy machine.
10	To study about different methods of surgical diathermy machine.

a. Course Name: Microcontroller and Interfacing

b. Course Code: 03614309

c. Prerequisite: Basic Understanding of fundamental concepts of electronics and basic circuit theory is crucial for comprehending how microcontrollers function and interact with peripheral devices.

d. Rationale: This course bridges the gap between theoretical electronics and practical application by teaching students how to apply concepts of digital logic, circuits, and programming to solve real-world problems using microcontrollers.

e. Course Learning Objective:

CLOBJ 1	Learn the internal structure, operation, and functionality of microcontrollers, including CPU, memory, timers, I/O ports, and communication interfaces.

CLOBJ 2	Gain proficiency in programming microcontrollers using assembly language and high-level languages like C to control devices and systems.
CLOBJ 3	Learn how to connect and interface various peripheral devices (sensors, actuators, displays, motors, etc.) to microcontrollers for real-world applications.
CLOBJ 4	Understand how to manage real-time operations, including configuring timers, handling interrupts, and implementing real-time processing in microcontroller-based systems.
CLOBJ 5	Develop the skills to troubleshoot and debug microcontroller hardware and software issues, using appropriate tools such as debuggers, logic analyzers, and oscilloscopes.

f. Course Learning Outcomes:

CLO 1	Understand and explain the architecture, functionality, and working principles of microcontrollers, including internal registers, memory organization, and input/output handling.
CLO 2	Develop, compile, and debug programs using assembly and C for microcontroller-based applications, ensuring the code is efficient and functional for hardware control.
CLO 3	Successfully design circuits and systems that interface various external components (such as sensors, motors, and displays) with microcontrollers to perform specific tasks.
CLO 4	Configure and use timers, interrupts, and real-time clock features to manage time-sensitive tasks and ensure accurate system operation in real-time applications.
CLO 5	Identify and solve issues related to microcontroller systems, both in terms of software (bugs, logic errors) and hardware (faulty components, communication issues), using debugging techniques and tools.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction** Introduction of Microcontrollers, Block diagram of microcontroller: CPU, input device, output device, memory and buses, common features of Microcontrollers, Differentiate between microprocessor and microcontroller, Differentiate between microprocessor and microcontroller, applications of microcontrollers.	**20%**	**10**
2	**8051 Hardware** Blocks of Microcontroller 8051, Pin Diagram of 8051, Clock circuit, reset Circuit, phase and state in machine cycle of 8051, Memory organization of 8051: Program and Data memory Map, External Memory Addressing and Decoding Logic of 8051, Memory organization of 8051: Program and Data memory Map, External Memory Addressing and Decoding Logic of 8051, Timers/Counters logic diagram and its operation in various modes, I/O Ports structure: Port 0, Port 1, Port 2, Port 3.	**25%**	**16**
3	**Moving Data Instruction Set** Addressing Modes, External Data Moves, Code memory Read-only Data Moves, Push and Pop opcodes, Data exchanges, Example programs.	**20%**	**10**
4	**Arithmetic and Logical Operations** Byte Level Logical Operation, Bit Level Logical Operation, Rotate and Swap Operation, Flags, Incrementing and Decrementing, Additions, Subtraction, Multiplications and Division, Decimal Arithmetic, Example Programs, Jump and Call Program Range, Calls and Subroutines, Interrupts and Returns.	**25%**	**12**
5	**8051 Interfacing and Biomedical Applications** Interfacing- keyboard, LCD, LED, ADC, DAC, Patient data acquisition systems, Serial Communication of 8051.	**10%**	**12**
	Total:	**100 %**	**60**

i. Text Book and Reference Book:

1. 8051 Microcontroller & Embedded system using assembly & c. – By Muhmmad Mazidi;

Pearson; Second.

2. The 8051 Microcontroller: Architecture- By Kenneth Ayala; Delmar Cengage Learning.

a. **Course Name:** Microcontroller and Interfacing Lab
b. **Course Code:** 03614310
c. **Prerequisite:** Understanding of fundamental electronics concepts such as voltage, current, resistance, transistors, and basic circuits is essential for designing and testing circuits that interface with microcontrollers.
d. **Rationale:** This course allows students to gain practical experience by directly working with microcontrollers and interfacing them with sensors, actuators, and other peripherals. This complements theoretical learning and helps students understand how microcontrollers function in real-world applications.
e. **Course Learning Objective:**

CLOBJ 1	Gain practical knowledge of microcontroller architecture and understand how internal components like registers, memory, and peripherals function.
CLOBJ 2	Learn how to write, compile, and execute programs in assembly or C language to control microcontroller operations and interact with peripheral devices.
CLOBJ 3	Develop skills to connect and interface various external devices such as sensors, actuators, displays, and motors with microcontrollers, enabling them to perform specific tasks.
CLOBJ 4	Learn to configure and implement communication protocols such as I2C, SPI, and UART to facilitate data exchange between microcontrollers and external devices.
CLOBJ 5	Develop the ability to diagnose, troubleshoot, and debug both hardware (circuit design) and software (programming) issues in microcontroller-based systems.
CLOBJ 6	Understand and implement real-time operations in microcontroller systems, including using timers, interrupts, and handling concurrent processes.

f. **Course Learning Outcomes:**

CLO 1	Write and debug efficient programs in assembly or C language to control microcontroller functionality and execute tasks based on real-time requirements.
CLO 2	Design and implement circuits that interface microcontrollers with external devices such as sensors, actuators, LEDs, motors, and displays, ensuring proper signal and power handling.
CLO 3	Set up and successfully use communication protocols like I2C, SPI, and UART to enable data exchange between microcontrollers and other systems or devices.
CLO 4	Create, implement, and test functional embedded systems, such as automated control systems or sensor-driven devices, by combining microcontroller programming and interfacing skills.

CLO 5	Identify and resolve issues in microcontroller systems, whether hardware-related (faulty connections, incorrect component selection) or software-related (coding errors, incorrect logic).
CLO 6	Use timers, interrupts, and other real-time processing techniques to manage time-sensitive tasks and ensure that microcontroller systems operate efficiently in real-world applications.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	30	-	20	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. No.	Experiment List
1	Perform addition programming using 8051.
2	Perform subtraction programming using 8051.
3	Perform multiplication and division programming using 8051.
4	Demonstrate byte and bit logical operation using assembly level programming.
5	Check the 8051 oscillator circuit and timing diagram.
6	Interface LED display using 8051.
7	Interface A to D converter using 8051.
8	Interface D to A converter using 8051.
9	Develop Timer / counter control logic using 8051.
10	Use commands to move data for for the biomedical applications using 8051.
11	Interface External memory circuit with 8051.
12	Interface External memory circuit with 8051.

a. Course Name: Summer Internship

b. Course Code: 03614312

c. Prerequisite: Students should have completed core courses related to their field of study, ensuring they possess the necessary foundational knowledge in subjects like engineering, or other relevant fields.

d. Rationale: This Course provides benefits to the students for chosen industry, helping them understand industry practices, standards, and work culture. This experience bridges the gap between academic learning and professional expectations.

e. Course Learning Objective:

CLOBJ 1	Enhance both technical expertise and soft skills through hands-on experience.
CLOBJ 2	Integrate theoretical concepts learned in the classroom into practical work environments, solving real-world problems in their field of study.
CLOBJ 3	Understand industry-specific processes, workflows, and standards by actively participating in professional tasks, projects, and collaborations.
CLOBJ 4	Learn how to approach and solve industry-relevant challenges, make decisions under real-world constraints, and adapt theoretical knowledge to practical situations.
CLOBJ 5	Experience and adapt to the professional environment, including workplace ethics, teamwork, communication, and interpersonal interactions in a business setting.

f. Course Learning Outcomes:

CLO 1	Apply academic theories, methodologies, and principles to real-world problems and projects encountered during the internship.
CLO 2	Demonstrate the ability to communicate clearly and professionally in both written and oral formats, including reporting, presentations, and teamwork.
CLO 3	Work collaboratively with colleagues, supervisors, and teams, contributing to the completion of tasks or projects in a productive manner.
CLO 4	Use industry-standard tools, software, and techniques to complete tasks relevant to the field of study, showcasing adaptability and technical competency.
CLO 5	Display appropriate professional behavior, including punctuality, responsibility, accountability, and adherence to ethical standards in the workplace.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**-**	**2**	**-**	**-**	**100**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

a. **Course Name:** Major Project-I
b. **Course Code:** 03614318
c. **Prerequisite:** Familiarity with relevant theories and concepts in your field of study and availability of literature and data sources for research.
d. **Rationale:** This course discuss how the problem aligns with current trends, challenges, or needs within the industry or academic discipline.

e. **Course Learning Objective:**

CLOBJ 1	Develop an understanding of project management principles, methodologies, and tools.
CLOBJ 2	Conduct thorough research on the chosen topic, including literature review and data collection.
CLOBJ 3	Gain proficiency in relevant technical skills and tools necessary for project completion.
CLOBJ 4	Apply critical thinking and problem-solving skills to identify and evaluate solutions to complex issues.
CLOBJ 5	Work effectively in a team environment, contributing to group discussions, decision-making, and project execution.

f. **Course Learning Outcomes:**

CLO 1	Successfully plan, execute, and complete a major project within the specified timeline and scope.
CLO 2	Demonstrate the ability to conduct independent research, including the collection, analysis, and interpretation of data.
CLO 3	Exhibit proficiency in the technical skills required for the project, such as programming, design, or engineering techniques.
CLO 4	Show the ability to analyze problems critically and develop logical solutions based on evidence.
CLO 5	Demonstrate effective teamwork and collaboration skills, contributing positively to group dynamics and project outcomes.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**12**	**6**	**-**	**-**	**60**	**-**	**40**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

SEMESTER 6

a. **Course Name:** Indian Constitution

b. **Course Code:** 03600351

c. **Prerequisite:** Zeal to learn Subject

d. **Rationale:** The course aims to give brief knowledge of Indian Constitution and administration of different bodies of India. To make governance better an engineer must conduce to E-governance through computers and knowledge of cyber laws. An engineer must know the limits of state action and regulations by acquainting himself with the laws that applied by the bureaucrats. Since an engineer works at different places and sights, he must have the basic knowledge of centre -state relations with reference to policy of financing the key projects. The knowledge of Constitution is necessary for him in order to ensure that the rules and regulations under which public and private sector works, do not violate the provisions of the Constitution. Knowledge of corporate culture is necessary for him. He must understand the compulsions of the public private partnership and philosophy of state ownership of key industries.

e. **Course Learning Objective:**

CLOBJ 1	Understand the historical context and significance of the Indian Constitution, including the Preamble and its interpretation.
CLOBJ 2	Comprehend the structure and roles of the Union Government, including the President, Prime Minister, and Parliament.
CLOBJ 3	Gain insight into the functions and powers of State Governments, including the roles of Governors, Chief Ministers, and State Legislatures.
CLOBJ 4	Familiarize with the structure and functions of local administration, including District Administration, Municipal Corporations, and Zila Panchayats.
CLOBJ 5	Understand the role and functioning of the Election Commission, including the Chief Election Commissioner and State Election Commissions, in conducting free and fair elections in India.

f. **Course Learning Outcomes:**

CLO 1	Understanding the Constitution.
CLO 2	Ability to understand, Union Government State Government , Local Administration and Election Commission.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	0	0	0	20	20	-	0	-	40

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**THE CONSTITUTION -INTRODUCTION:** The History of the Making of the Indian Constitution Preamble and the Basic Structure, and its interpretation Fundamental Rights and Duties and their interpretation, State Policy Principles.	**25%**	**7**
2	**UNION GOVERNMENT:** Structure of the Indian Union, President -Role and Power, Prime Minister and Council of Ministers, Lok Sabha and Rajya Sabha	**20%**	**5**
3	**STATE GOVERNMENT:** Governor -Role and Power, Chief Minister and Council of Ministers, State Secretariat.	**20%**	**4**
4	**LOCAL ADMINISTRATION:** District Administration, Municipal Corporation, Zila Panchayat	**15%**	**4**
5	**ELECTION COMMISSION:** Role and Functioning, Chief Election Commissioner, State Election Commission	**20%**	**4**

i. Text Book and Reference Book:

1. An Introduction to the Constitution of India
   D.D. Basu; Prentice Hall, New Delhi
2. An Introduction to the Constitution of India
   M. V. Pylee; Vikas New Delhi

a. **Course Name:** Signal Processing for Biomedical
b. **Course Code:** 03614351
c. **Prerequisite:** Basic knowledge of Signal and System and Mathematics is required.
d. **Rationale:** To provide a thorough understanding and working knowledge of design, implementation and analysis DSP systems.
e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of common biomedical signals and their physiological origins.
CLOBJ 2	Apply time-domain and frequency-domain analysis techniques to understand the characteristics of biomedical signals.
CLOBJ 3	Design and implement digital filters (FIR and IIR) for noise reduction, signal enhancement, and feature extraction in biomedical signals.
CLOBJ 4	Analyze and evaluate the performance of biomedical signal processing systems, including accuracy, sensitivity, specificity, and robustness.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate the ability to analyze and interpret various types of biomedical signals, understanding their physiological origin and diagnostic significance.
CLO 2	Successfully apply appropriate filtering techniques to remove noise and artifacts from biomedical signals, thereby improving signal clarity and diagnostic potential.
CLO 3	Identify, extract, and analyze key features in biomedical signals using computational tools for diagnostic and monitoring purposes.
CLO 4	Proficiently use signal processing software (e.g., MATLAB) to implement signal processing workflows for real-world biomedical applications.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Classification of Signals and Systems** Concept of signals, Classification of signals, Examples related to signals, Singularity functions, Classification of systems, Representation of systems, Examples related to systems.	**25%**	**12**
2	**Conversion of Signals** Need of the quantization and its importance, Block-Diagram of Analog to digital converter, Block-Diagram of Source coding, Block-Diagram of Channel coding.	**15%**	**6**
3	**Concepts of Digital Filtering** Concept of Digital filters, Types of filters, Advantages of digital filters over analog filters, FIR filter, characteristics of FIR filter, Parameters of FIR Filters, IIR filter, and characteristics of IIR filter, Difference between FIR & IIR Filter. Block-Diagram of Adaptive filter.	**20%**	**10**
4	**Time Frequency Signal Analysis Methods** Trigonometric Fourier series, Fourier transform, Characteristics of Fourier transform, Correlation & Convolution properties, Some examples based on correlation and convolution, Methods of correlation and convolutions: Analytical (Mathematical Expression), Tabular and Graphical methods. Frequency domain analysis of ECG signal, Basic concept of wavelet, Techniques of Wavelet transform, Applications of wavelet transform in biomedical instruments, Circular convolution, Examples based on circular convolution.	**25%**	**15**
5	**Data Reduction Techniques** Data reduction techniques, Types of data reduction techniques based on lossy and lossless algorithm, Redundancy, Irrelevancy removal.	**15%**	**5**
	Total:	**100 %**	**48**

i. Text Book and Reference Book:

1. Biomedical Digital Signal Processing, By Willis J. Tompkins; Prentice-Hall Of India Pvt. Limited.
2. Biomedical Signal Analysis A case study approach, By Rangaraj M. Rangayyan; Wiley, 2002 .
3. Digital Signal Processing, By Salivahanan S. , Vallavaraj A., Gnanapriya C.; Tata

McGraw-Hill, New Delhi, 2008.
4. Biomedical Signal and Image Processing, By Najarian Kayvan; CRC Press, 2009.
5. Digital Signal Processing: Principles Algorithms and Applications, By Proakis J. G.and Manolakis D.G.; Pearson Education; 4th Edition, 2014.

a. **Course Name:** Signal Processing for Biomedical Lab
b. **Course Code:** 03614352
c. **Prerequisite:** Basic understanding of biomedical signals, basic signal processing concepts like Fourier transforms, sampling, and filtering, as well as proficiency in digital signal processing (DSP) techniques such as designing FIR and IIR filters is required. Students should be familiar with software tools like MATLAB for signal analysis.
d. **Rationale:** To provide students with hands-on experience in applying theoretical concepts from biomedical engineering to real-world clinical scenarios, fostering interdisciplinary skills essential for healthcare innovation.
e. **Course Learning Objective:**

CLOBJ 1	Analyze various types of biomedical signals (e.g., ECG, EEG, EMG) in both time and frequency domains to extract relevant features.
CLOBJ 2	Design and apply digital filters (FIR and IIR) to enhance signal quality and reduce noise in biomedical data.
CLOBJ 3	Use software platforms such as MATLAB for the acquisition, processing, and visualization of biomedical signals.
CLOBJ 4	Identify common sources of noise and artefacts in biomedical signals and implement strategies to mitigate their effects.

f. **Course Learning Outcomes:**

CLO 1	Analyze and interpret biomedical signals, identifying key features and patterns that are significant for medical diagnostics.
CLO 2	Design and implement appropriate digital filters that improve the quality of biomedical signals, demonstrating an understanding of filter characteristics and performance.
CLO 3	Effectively perform data acquisition from biomedical sensors and transducers, ensuring accurate digitization and processing of signals.
CLO 4	Communicate findings from laboratory experiments clearly and effectively, both in written reports and oral presentations, highlighting the relevance to clinical applications.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	30	-	20	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. NO.	Experiment List
1	Introduction to MATLAB as a tool for signal processing.
2	Identify the nature of various biomedical signals.
3	Use open source software library for analysis of bio-signals.
4	Write programs for Low Pass digital filter in MATLAB.
5	Write programs for High Pass digital filter in MATLAB.
6	Write programs for Band Pass digital filter in MATLAB.
7	Write programs for Bandstop (Notch) digital filter in MATLAB.
8	Implementation of FFT and Inverse FFT Algorithms.
9	Use of FDA Tool of signal processing toolbox in MATLAB.
10	To study about R-Peak Detection of ECG signal using Pan-Tompkins Algorithms.

a. Course Name: Rehabilitation Engineering

b. Course Code: 03614353

c. Prerequisite: Basic knowledge about to develop orthosis and prosthesis and to maintain the sensory and motor rehabilitation systems.

d. Rationale: To enhance the quality of life for individuals with disabilities by developing innovative assistive technologies that promote independence and accessibility.

e. Course Learning Objective:

CLOBJ 1	Explain the fundamental principles and concepts of rehabilitation engineering, including its role in enhancing functional independence for individuals with disabilities.
CLOBJ 2	Develop designs for assistive devices, such as prosthetics, orthotics, and mobility aids, using engineering principles and user-centered design approaches.

CLOBJ 3	Assess and evaluate the effectiveness, usability, and safety of various rehabilitation devices and assistive technologies.
CLOBJ 4	Integrate knowledge from biomedical engineering, clinical practices, and rehabilitation therapy to address complex challenges in rehabilitation engineering.

f. Course Learning Outcomes:

CLO 1	Demonstrate a comprehensive understanding of rehabilitation engineering concepts and principles, including relevant laws and regulations.
CLO 2	Create and prototype assistive devices tailored to meet the specific needs of individuals with disabilities, using appropriate engineering tools and techniques.
CLO 3	Analyze the performance of rehabilitation devices through testing and evaluation, using established metrics to assess effectiveness and usability.
CLO 4	Conduct independent research on rehabilitation technologies, including literature review, experimental design, and analysis of data.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	**Content**	**Weightage (%)**	**Teaching Hours**
1	**Introduction of Rehabilitation** Concept of Rehabilitation, terms related to Rehabilitation, Engineering concepts in sensory rehabilitation, Engineering concepts in motor rehabilitation, Future scopes of Rehabilitation.	**10%**	**8**
2	**Orthotics and Prosthetics in Rehabilitation** Computer aided engineering in component design, Intelligent prosthetic knee, Hierchically controlled prosthetic hand,	**20%**	**10**

	myoelectric hand, Orthotic knee joint, Externally powered and controlled orthosis and prosthesis: Functional Electrical Stimulation systems-restoration of hand, restoration of standing and walking, Hybrid assistive system for walking.		
3	**Wheel Chair** Concepts of Walking mobility: Wheelchairs, Types of Wheelchairs, functions of Wheelchairs, Structure and component design of wheelchair, Power wheelchair, Maintenance Procedure of Power Wheelchair.	**25%**	**10**
4	**Electronic Travel Applications (ETA) in rehabilitation** Introduction of Electronic travel aid and their application, Laser cane, basic principle of LASER cane, Ultrasonic blind detector, Ultrasonic binaural sensing, Various Disabilities.	**20%**	**6**
5	**Sensory Augmentation and Substitution** Visual systems: Visual augmentation, Tactual vision substitution, Auditory vision substitution. Auditory system: Auditory augmentation, Visual auditory substitution, Tactual auditory substitution Tactual system: Tactual augmentation, Tactual augmentation.	**25%**	**8**
	Total:	**100 %**	**42**

i. Text Book and Reference Book:

1. Handbook of Biomedical Engineering, second edition ´Volume II, By Bronzino Joseph D.; CRC press, 2010.
2. An Introduction to Rehabilitation, By Cooper Rory A.; Taylor and Francis, London, 2012.

a. Course Name: Rehabilitation Engineering Lab

b. Course Code: 03614354

c. Prerequisite: Basic knowledge in engineering principles, human physiology, and computer-aided design.

d. Rationale: To provide hands-on experience for students to develop innovative assistive technologies, fostering practical skills and interdisciplinary collaboration to enhance the quality of life for individuals with disabilities.

e. Course Learning Objective:

CLOBJ 1	Utilize fundamental engineering principles to design and develop assistive devices that meet the specific needs of individuals with disabilities.

CLOBJ 2	Perform experiments to evaluate the performance and functionality of various rehabilitation technologies and assistive devices.
CLOBJ 3	Create prototypes of assistive technologies, incorporating user-centered design principles to ensure usability and effectiveness.
CLOBJ 4	Use software tools for simulations and data analysis related to rehabilitation engineering projects.

f. Course Learning Outcomes:

CLO 1	Demonstrate proficiency in designing, prototyping, and testing assistive devices tailored for individuals with disabilities.
CLO 2	Evaluate the performance and usability of rehabilitation technologies through systematic testing and user feedback.
CLO 3	Analyze and interpret experimental data to draw meaningful conclusions regarding the effectiveness of rehabilitation devices.
CLO 4	Apply user-centered design principles in the development of assistive devices, ensuring that the needs and preferences of users are prioritized.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. NO.	**Experiment List**
1	Use engineering concept in sensory & motor rehabilitation.
2	Demonstration of intelligent prosthetic knee, prosthetic hand.
3	Demonstration of externally powered and controlled orthotics and prosthetics-FES.
4	Demonstration of intelligent hand prosthesis (MARCUS).
5	Operate wheel chair.
6	Find centre of gravity of wheel chair.
7	Demonstrate Braille printing system.
8	Assembling power wheel chair.

9	Maintain power wheel chair.
10	Demonstrate the performance of polarized ultrasonic travel aid.

a. **Course Name:** Major Project-II
b. **Course Code:** 03614360
c. **Prerequisite:** Basic knowledge of Basic Electronics, microcontroller and biomedical instrumentation required.
d. **Rationale:** To make students understand basic concepts of electronics and instrumentation which will help them to create new innovation.
e. **Course Learning Objective:**

CLOBJ 1	Integrate and apply theoretical concepts and technical skills acquired throughout their academic program to develop a comprehensive project.
CLOBJ 2	Effectively plan and manage project timelines, resources, and deliverables, demonstrating project management principles.
CLOBJ 3	Design, develop, and implement a solution to a defined problem, utilizing appropriate engineering tools and techniques.
CLOBJ 4	Evaluate the performance and functionality of the developed solution through systematic testing and analysis.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate a comprehensive understanding of the project topic, including relevant theories, principles, and applications.
CLO 2	Exhibit effective project management skills by developing a clear project plan, setting milestones, and adhering to timelines.
CLO 3	Develop a functional prototype or solution that addresses the identified problem, showcasing technical and design capabilities.
CLO 4	Analyze and interpret project results, drawing meaningful conclusions and insights from experimental data and evaluations.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**12**	**6**	**-**	**-**	**60**	**-**	**40**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

a. **Course Name:** Telemedical Instrumentation
b. **Course Code:** 03614381
c. **Prerequisite:** Basic knowledge in biomedical engineering, electrical circuits, and signal processing.
d. **Rationale:** To enhance healthcare access and patient monitoring through innovative technologies that enable remote diagnosis and treatment.
e. **Course Learning Objective:**

CLOBJ 1	Explain the fundamental concepts and principles of telemedicine and telemedical instrumentation, including their role in modern healthcare.
CLOBJ 2	Design and develop telemedical instruments that can accurately monitor and transmit patient health data.
CLOBJ 3	Apply signal processing techniques to analyze and interpret data obtained from telemedical devices.
CLOBJ 4	Implement appropriate communication protocols and networking technologies for data transmission in telemedicine applications.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate a comprehensive understanding of telemedicine concepts and the impact of telemedical instrumentation on healthcare delivery.
CLO 2	Develop functional prototypes of telemedical devices that successfully monitor and transmit patient data.
CLO 3	Analyze and interpret data from telemedical instruments, applying signal processing methods to extract meaningful information.
CLO 4	Implement effective networking solutions and communication protocols for reliable data transmission in telemedicine applications.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Fundamentals of Telemedicine** Concept of telemedicine, Block diagram of telemedicine system, Future Scopes of telemedicine, benefits and limitations of telemedicine, Applications of Telemedicine.	**15%**	**7**
2	**Types of Communication and Networking** Types of information: Audio, Video, Images, Text and Data, Fax, Types of communication, Types of Networking: PSTN, ISDN, Internet, Difference between Internet and Intranet. Wireless communications: Wave propagation, types of Wave propagation, GSM network (Global system for mobile communication), Satellite and micro wave, Real time telemedicine.	**25%**	**10**
3	**Data Exchanges** Data exchanges: Network configuration: Circuit switching, Packet switching, Difference between circuit switching network and packet switching network, Video conferencing: Block diagram of video conferencing, Applications.	**15%**	**8**
4	**Data Security and Standards** Cryptography, Data security and standards: Encryption, Block-diagram of Encryption, Mechanisms of encryption, Phases of encryption, Block-diagram of Decryption, Mechanisms of Decryption, Phases of Decryption. Protocols: Block-Diagram of TCP/IP model, Block-Diagram of OSI model, Ethical and legal aspects of Telemedicine: Confidentiality and Law, Patient rights and consent, Access to medical records.	**25%**	**10**
5	**Applications of Telemedicine in Medical Field** Tele radiology system, Block-Diagram of Tele radiology system, Tele pathology system, Tele-cardiology, Block-Diagram of Tele cardiology system, Tele-surgery, Applications of Mobile Health (M-Health) in telemedicine.	**20%**	**8**
	Total:	**100 %**	**43**

i. Text Book and Reference Book:

1. Computer networks, By Andrew S Tanenbaum; PHI Learning, New Delhi, 2010.
2. Data Communications and Networking, By B. A. Forouzan; Tata McGraw Hill; 4th Edition, 2010.
3. Electronic Communications, By Dennis Roddy & John Coolen; PHI, 2012.

a. Course Name: Telemedical Instrumentation Lab

b. Course Code: 03614382

c. Prerequisite: Basic Understanding of telemedicine, biomedical engineering, and signal processing.

d. Rationale: To provide hands-on experience in developing and testing telemedical technologies to enhance practical skills and address real-world healthcare.

e. Course Learning Objective:

CLOBJ 1	Apply theoretical concepts of telemedicine and biomedical instrumentation in practical experiments and projects.
CLOBJ 2	Design and develop telemedical instruments capable of monitoring and transmitting patient data accurately.
CLOBJ 3	Conduct experiments to evaluate the functionality and performance of various telemedical devices and systems.
CLOBJ 4	Analyze and interpret data collected from telemedical instruments using appropriate signal processing techniques.

f. Course Learning Outcomes:

CLO 1	Demonstrate practical skills in designing, building, and testing telemedical devices and systems.
CLO 2	Evaluate the performance of telemedical instruments through systematic testing and data analysis.
CLO 3	Analyze and interpret data obtained from telemedical devices, applying signal processing methods to extract meaningful insights.
CLO 4	Implement effective networking and communication solutions for reliable data transmission in telemedicine applications.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
-	-	2	1	-	-	30	-	20	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. No.	Experiment List
1	To study about ISDN.
2	Identify the layers of TCP/IP protocols.
3	Identify the layers of OSI protocols.
4	To study about circuit switching network.
5	To study about packet switching network.
6	Perform video conferencing using internet.
7	To study about the Global System for Mobile Communication.
8	To compare techniques of circuit switching with Packet switching.
9	To study about teleradiology system.
10	To study about telesurgery system.

a. Course Name: Artificial Organ

b. Course Code: 03614383

c. Prerequisite: Basic knowledge of biomedical engineering, material science, and medical instrumentation.

d. Rationale: To develop life-saving engineered solutions that mimic natural organ function, addressing the critical need for alternatives to organ transplants.

e. Course Learning Objective:

CLOBJ 1	Explain the physiological functions of major human organs and the underlying causes of organ failure.
CLOBJ 2	Understand the principles of designing artificial organs, including material selection, biocompatibility, and mechanical performance..
CLOBJ 3	Evaluate different engineering techniques, such as mechanical, electronic, and biological systems, used in the development of artificial organs.
CLOBJ 4	Study biomaterials and their applications in creating durable and biocompatible artificial organs.

f. Course Learning Outcomes:

CLO 1	Demonstrate a comprehensive understanding of the structure and function of natural organs and the medical conditions that lead to organ failure.
CLO 2	Design artificial organs that mimic the function of natural organs, incorporating appropriate biomaterials and engineering techniques.
CLO 3	Apply knowledge of biomechanics and biomaterials to create biocompatible and functional artificial organ systems.
CLO 4	Critically evaluate the performance and limitations of existing artificial organs and suggest improvements for future technologies.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction** Biomaterials used in artificial organs and prostheses, inflammation, rejection, correction. Rheological properties of blood, blood viscosity variation: effect of shear rate, hematocrit, temperature and protein contents. Casson equation, flow properties of blood through the blood vessels, problems associated with extracorporeal blood flow.	**15%**	**8**
2	**Artificial Kidney** Brief of kidney filtration, basic methods of artificial waste removal, hemodialysis, and equation for artificial kidney and middle molecule hypothesis. Hemodialysers: flat plate type, coil type and hollow fiber. Analysis of mass transfer in dialyers (cross current & cocurrent flow), regeneration of dialysate, membrane configuration, wearable artificial kidney machine, separation of antigens from blood in ESRD patients.	**25%**	**10**

3	**Artificial Heart Lung Machine** Brief of lungs gaseous exchange/transport, artificial heart-lung devices. Oxygenators: bubble, film oxygenators and membrane oxygenators. Gas flow rate and area for membrane oxygenators. Liver support system, artificial pancreas, blood and skin.	**20%**	**8**
4	**Hearing Aid Applications** Air conduction, bone conduction, masking, functional diagram of an audiometer. Hearing aids: different types, receiver amplifiers. Ophthalmoscope, retinoscope, I.A.B.P principle and application.	**15%**	**6**
5	**Advanced Biomaterials** New ceramics for joint replacement surgery, Composites for joint replacement surgery, New biomaterials for improving the blood and tissue compatibility of total artificial hearts (TAH), Ventricular assist devices (VAD), Recent advancement and future directions.	**25%**	**10**
	Total:	**100 %**	**42**

i. Text Book and Reference Book:

1. Handbook of Biomedical Instrumentation, By R.S.Khandpur.
2. Biomedical Engineering and Instrumentation, By Joseph Bronzino; PWS Engg, Boston.
3. Artificial Organs, By Gerald E. Miller; Morgan &Claypool Publishers, 2006.
4. Rehabilitation Engineering, By Robbinson C.J; CRC press, 1995.

a. Course Name: Artificial Organ Lab

b. Course Code: 03614384

c. Prerequisite: Basic knowledge of human physiology, biomaterials, and biomedical engineering principles.

d. Rationale: To provide hands-on experience in designing and testing artificial organs, bridging theory and practical application in healthcare innovation.

e. Course Learning Objective:

CLOBJ 1	Apply knowledge of human physiology, biomechanics, and biomaterials to the practical design of artificial organs.

CLOBJ 2	Gain hands-on experience in designing, fabricating, and prototyping artificial organs or organ systems.
CLOBJ 3	Conduct experiments to evaluate the performance and functionality of artificial organs under various conditions.
CLOBJ 4	Assess the biocompatibility of materials and systems used in artificial organs, focusing on their interaction with biological tissues.

f. Course Learning Outcomes:

CLO 1	Demonstrate proficiency in designing, fabricating, and testing artificial organs, applying relevant biomedical engineering principles.
CLO 2	Analyze the performance of artificial organs through systematic testing and data collection, assessing their functionality and reliability.
CLO 3	Evaluate the biocompatibility of materials used in artificial organ systems, understanding their interaction with biological tissues.
CLO 4	Identify and solve challenges in the development and testing of artificial organs using analytical and critical thinking skills.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. No.	**Experiment List**
1	To Study about introduction of artificial organ.
2	To Study about Artificial kidney.
3	To Study about dialyzers used in artificial kidney.
4	To Study about artificial heart lung machine.
5	To Study about types of oxygenators used in artificial heart lung machine.
6	To Study about ophthalmoscope.
7	To Study about retinoscopy.

8	To Study about advanced biomaterials used in artificial organ.
9	To Study about ventricular assist device (VAD).
10	To Study about total artificial heart (TAH).

a. **Course Name:** Biomaterials and Implants
b. **Course Code:** 03614385
c. **Prerequisite:** Basic knowledge of material science, biology, and biomedical engineering.
d. **Rationale:** To understand the development and application of biocompatible materials for medical implants that interact safely with human tissues.
e. **Course Learning Objective:**

CLOBJ 1	Explain the physical, chemical, and biological properties of biomaterials used in medical implants.
CLOBJ 2	Assess the biocompatibility of various materials and their interaction with human tissues.
CLOBJ 3	Understand the principles and considerations involved in the design of medical implants, including mechanical strength, durability, and material selection.
CLOBJ 4	Analyze the performance of biomaterials under physiological conditions, considering factors such as wear, corrosion, and degradation.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate a thorough understanding of the properties and types of biomaterials used in medical implants.
CLO 2	Evaluate the biocompatibility of different materials and predict their interactions with biological tissues.
CLO 3	Apply knowledge of material properties and mechanical requirements to design and select appropriate biomaterials for specific medical implants.
CLO 4	Analyze how biomaterials perform under physiological conditions and how factors like wear, corrosion, and biological reactions impact their functionality.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Fundamentals of Bio-Materials and Implants** Need of biomaterial, Classification of materials based on nature, Construction of bio-material, Impact of bio-material, Performance of implants, Tissue response to implants.	**15%**	**8**
2	**Metals and Ceramics** Stainless steel, Cobalt-chromium alloys, Titanium based alloys, Nitinol: Shape memory effect, Carbons, Alumina, Surface reactive ceramics: Bio-glass, Ceravital, Manufacturing process of Biomaterials.	**25%**	**10**
3	**Polymers** Polymerization: Types of Polymerization process, polymer chain, Polymers in bio-medical use, types of polymer: Polyethylene, polypropylene, Per-fluorinated polymers, Acrylic polymers, Polyamides and Poly Methyl Methacrylate (PMMA), Silicon rubber.	**20%**	**8**
4	**Inflammation and Infection** Inflammation, Types of Inflammation: Acute inflammation and Chronic inflammation, Infection, Biocompatibility.	**15%**	**5**
5	**Applications of Bio-Materials and Implants in Medical Field** Heart Valve implants: Mechanical valves: Caged ball valve, Tilting disc valve, Bi- leaflet valve, Biological valve and synthetic valve. Cardiac pacemaker, Circulatory assist device (LVAD), Stent, Grafts: types of grafts Optical implants: Contact lens and IOL (Intraocular lens) Dental implants: Impression materials, Fillings and restoration materials, types of dental implants. Orthopedic implant: Total Hip Replacement (THR), Knee Replacement.	**25%**	**12**
	Total:	**100 %**	**43**

i. Text Book and Reference Book:

1. Biomaterials Second Edition, By Sujata V. Bhatt, Narosa Publishing House, 2005.

2. Biomaterials - Principles and Applications, By Joon B. Park Joseph D. Bronzino.

a. **Course Name:** Biomaterials and Implants Lab
b. **Course Code:** 03614386
c. **Prerequisite:** Basic knowledge of material science, biology, and biomedical engineering.
d. **Rationale:** To provide hands-on experience in testing and evaluating biomaterials for their suitability and biocompatibility in medical implants.
e. **Course Learning Objective:**

CLOBJ 1	Perform experiments to test the physical, chemical, and mechanical properties of biomaterials used in implants.
CLOBJ 2	Assess the biocompatibility of different materials, evaluating how they interact with biological tissues.
CLOBJ 3	Study the degradation and wear behavior of biomaterials under simulated physiological conditions.
CLOBJ 4	Conduct mechanical testing to evaluate the strength, elasticity, and durability of materials used in medical implants.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate proficiency in testing and analyzing the properties of biomaterials used in medical implants.
CLO 2	Evaluate the biocompatibility of various biomaterials based on experimental results and predict their suitability for medical applications.
CLO 3	Analyze the degradation and wear patterns of biomaterials, understanding how these factors impact implant performance.
CLO 4	Perform mechanical tests to measure material properties such as tensile strength, fatigue resistance, and elasticity.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. No.	Experiment List
1	Identify various implants used in biomedical field.
2	Identify various metals and alloys used in biomedical field.
3	Identify various ceramics used in biomedical field.
4	Identify various polymers used in biomedical field.
5	List characteristics of tissue response to implants.
6	To Study about different dental implants.
7	To Study about cardiac valve implants.
8	To Study about cardiac pacemaker implantation.
9	To Study about different Intra ocular implants.
10	To study about Total Hip Replacement.

a. Course Name: Tissue Engineering

b. Course Code: 03614387

c. Prerequisite: Basic foundational knowledge in cell biology, biomaterials, and biomedical engineering.

d. Rationale: To develop innovative strategies for repairing or replacing damaged tissues and organs by combining cells, biomaterials, and engineering principles.

e. Course Learning Objective:

CLOBJ 1	Describe the structure and function of different types of tissues and the cellular mechanisms involved in tissue repair and regeneration.
CLOBJ 2	Identify and analyze various biomaterials used in tissue engineering applications, focusing on their properties and interactions with biological tissues.
CLOBJ 3	Examine the interactions between cells and the extracellular matrix, understanding how these interactions influence tissue development and function.
CLOBJ 4	Develop and design tissue-engineered constructs, considering factors such as scaffold design, cell sourcing, and bioreactor conditions.

f. Course Learning Outcomes:

CLO 1	Demonstrate a thorough understanding of the structure, function, and biology of various tissues.
CLO 2	Evaluate and select appropriate biomaterials for specific tissue engineering applications based on their properties and compatibility.

CLO 3	Analyze the behaviour of cells in response to different scaffolds and environmental conditions, understanding their implications for tissue regeneration.
CLO 4	Design and propose effective tissue-engineered constructs that promote cell growth and tissue development.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction** Introduction to tissue engineering: Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cell characteristics morphology, number viability, motility and functions. Measurement of tissue characteristics, appearance, cellular component, ECM component, mechanical measurements and physical properties.	15%	8
2	**Tissue Architecture** Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix& Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering.	15%	6
3	**Biomaterials** Biomaterials: Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology.	20%	8

4	**Basic Biology of Stem Cells** Stem Cells: Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis, Differentiation, Stem cell systems Liver, neuronal stem cells, Types & sources of stem cell with characteristics: embryonic, adult, hematopoietic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuripotent stem cells.	**25%**	**10**
5	**Clinical Applications** Stem cell therapy, Molecular therapy, In vitro organogenesis, Neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopedic applications, Stem cells and Gene therapy Physiological models, issue engineered therapies, product characterization, components, safety, efficacy. Preservation ´freezing and drying. Patent protection and regulation of tissue-engineered products, ethical issues.	**25%**	**10**
	Total:	**100 %**	**42**

i. Text Book and Reference Book:

1. Biomaterials Medical Devices and Tissue Engineering, By Fredrick H. Silver Chapman and Hall.
2. Tissue engineering: Principles for the design of replacement organs and tissues, By W. Mark Saltzman; Oxford University Press.

a. Course Name: Tissue Engineering Lab
b. Course Code: 03614388
c. Prerequisite: Basic foundational knowledge in cell biology and biomaterials.
d. Rationale: To provide practical experience in designing and analyzing tissue-engineered constructs, bridging theoretical concepts with real-world applications in tissue repair and regeneration.
e. Course Learning Objective:

CLOBJ 1	Demonstrate proficiency in culturing various cell types, including stem cells and primary cells, under aseptic conditions.
CLOBJ 2	Prepare and characterize biomaterials for tissue engineering applications, including scaffolds and hydrogels.

CLOBJ 3	Design and fabricate tissue-engineered constructs using appropriate techniques and materials.
CLOBJ 4	Investigate and analyze cellular responses to different biomaterials and environmental conditions.

f. Course Learning Outcomes:

CLO 1	Show proficiency in culturing various cell types and maintaining aseptic conditions throughout experiments.
CLO 2	Evaluate the properties and suitability of different biomaterials for specific tissue engineering applications.
CLO 3	Design and create effective tissue-engineered constructs that promote cell growth and tissue regeneration.
CLO 4	Analyze and interpret the behaviour of cells in response to various biomaterials and culture conditions.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Experiments:

Sr. No.	**Experiment List**
1	To Study about introduction of tissue engineering.
2	To Study about tissue architecture.
3	To Study about Biomaterial used in tissue engineering.
4	To Study about stem cells and its sources of origination.
5	To Study about applications of tissue engineering.
6	To Study about Molecular therapy.
7	To Study about Gene therapy.
8	To Study about Preservation process of tissues.