Bharati Vidyapeeth

(Deemed to be University)

Pune, India

College of Engineering, Pune

Minor Degree Programme

B.Tech.

(All branches)

(As per 2023 curriculum)

VISION OF UNIVERSITY:

Social Transformation through Dynamic Education

MISSION OF UNIVERSITY:

- To make available quality education in different areas of knowledge to the students as per their choice and inclination
- To offer education to the students in a conducive ambience created by enriched infrastructure! and academic facilities in its campuses
- To bring education within the reach of rural, tribal and girl students by providing them substantive fee concessions and subsidized hostel and mess facilities
- To make available quality education to the students of rural, tribal and other deprived sections of the population

VISION OF THE INSTITUTE:

To be World Class Institute for Social Transformation Through Dynamic Education.

MISSION OF THE INSTITUTE:

- To provide quality technical education with advanced equipment, qualified faculty members, infrastructure to meet needs of profession and society.
- To provide an environment conducive to innovation, creativity, research and entrepreneurial leadership.
- To practice and promote professional ethics, transparency and accountability for social community, economic and environmental conditions.

BHARATI VIDYAPEETH
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COLLEGE OF ENGINEERING, PUNE

List of Minor Degree Programmes offered by University from A.Y 2024-25

for B.Tech – All branches (As per NEP 2023 Curriculum)

Sr.No.	Name of the branch	Name of the Minor Degree Programme
1	Chemical	1. Bioprocess Technology 2. Waste water treatment
2	Civil	1. Integrated Building System 2. Green Infrastructure
3	Computer Engineering.	1. Artificial Intelligence & Data Science 2. Artificial Intelligence & Game Development 3. Cyber Security
4	Computer Science & Engineering	1. Blockchain
5	Computer Science & Business System	1. Business Systems
6	Information Technology	1. Cloud Technologies
7	Electrical & Computer	1. Electrical Vehicles
8	Electronics & Communication	1. Internet of Things
9	Electronics & Telecommunication	1 AI in Health Care
10	Mechanical	1. 3D Printing 2. Energy Engineering
11	Robotics & Automation	1. Robotics 2. Industry 5.0

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COLLEGE OF ENGINEERING, PUNE

B. Tech. (Chemical) (2023 Course)

Minor Degree Programme I: Bioprocess Technology

Sr. No.	Category	Semester	Course	Teaching Scheme			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1	MI	III	Fundamental of Bioprocess Technology	3	2	-	60	40	25	-	25	150	3	1	-	4
2	MI	IV	Enzyme Technology	3	2	-	60	40	25	-	25	150	3	1	-	4
3	MI	V	Fermentation Technology	3	2	-	60	40	25	25	-	150	3	1	-	4
4	MI	VI	Downstream Technology	3	2	-	60	40	25	25	-	150	3	1	-	4
5	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
Total				**12**	**12**	**-**	**240**	**160**	**150**	**50**	**100**	**700**	**12**	**08**	**-**	**20**

FUNDAMENTAL OF BIOPROCESS TECHNOLOGY					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: Biology, Biological Sciences, and Chemistry

Course Outcomes

After completion of the course students would be able to:

1	Learn bio- energies for the biochemical processes.
2	Learn the biochemistry of carbohydrates and lipids.
3	Learn the biochemistry of proteins and nucleic acid.
4	Analyze importance of media in microbial growth.
5	Understand importance of nutritional growth factors.
6	Learn the kinetics of the bioprocesses.

Topics covered

UNIT-I	**Biochemical Organization and Bioenergetics** Component of the cell, structural organization of bacteria and other microorganisms, biochemical functions, Transport through biological cell membrane, the concept of free energy, determination of change in free energy from equilibrium constant and reduction potential, bioenergetics and biological oxidation, concept of oxidation and reduction, Identification of Microorganisms - Structure, properties and classification - Prokaryotes & Eukaryotes; Bacterial Taxonomy	**(06 Hours)**
UNIT-II	**Biomolecules -I** **Carbohydrates** – classification, properties, metabolism of carbohydrates – gluconeogenesis, glycogenolysis, glycolysis. citric acid cycle and its biological	**(06 Hours)**

	significance, role of sugar in nucleotide biosynthesis and pentose phosphate pathway. **Lipids** – Classification, properties. sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, metabolism of lipids, oxidation of fatty acids, α, β - oxidation and biosynthesis of ketone bodies, cholesterol, porphyrin biosynthesis, metabolism of bile pigments.	
UNIT-III	**Biomolecules -II** **Proteins and amino acids** – Classification, properties, biosynthesis of amino acids and proteins, essential amino acids, metabolism of amino acids and proteins, Nitrogen balance. **Nucleic acids** Genetic code, nucleic acids, and structure of DNA and RNA, purine biosynthesis and pyrimidine biosynthesis	**(06 Hours)**
UNIT-IV	**Upstream Processing** Isolation, Preservation and Improvement of Industrial Micro-Organisms; Medium requirements different processes; Criteria for good medium; Sterilization - batch and continuous heat sterilization of liquid media, Medium constituents, Designing of medium and its optimization. Improvement of industrially important microbes,	**(06 Hours)**
UNIT-V	**Microbial Nutrition, Growth and Metabolism** Nutritional requirements of bacteria; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules	**(06 Hours)**
UNIT-VI	**Kinetics** Microbial growth kinetics, Factors affecting the growth, Mass balance, Stoichiometry, and Measurement of growth, Design of bioreactor	**(06 Hours)**
Project Based Learning		
1	List out all the principles of the analytical techniques used in bioprocesses.	
2	Find out different types of proteins with structure.	
3	Search out some industries related to bio-separation.	
4	Write a technical report on your visit to a process industry.	
5	Give fifteen minutes presentation (seminar) on particular topic and prepare a report.	
6	Perform isolation of bacteria from soil	

7	Group discussion on merits and de-merits of bioprocess technology
Term Work: The term-work shall include a record of at least six experiments, related to each syllabus unit, conducted by the student.	
1	Qualitative analysis of proteins
2	Introduction to principles of sterile techniques
3	Qualitative analysis of lipids
4	Quantitative analysis of carbohydrates
5	Culture Media-Types and Use; Preparation of Nutrient broth and agar
6	Culture Techniques, Isolation and Preservation of Cultures
7	Culture Techniques by Pour plate, streak plate
8	Microscopy – Working and care of Microscope
9	Gram's Staining
10	Growth Curve in Bacteria
Text Books/Reference Books	
1	Bruce A. Alexander J. Julian L., Martin R. Keith R. and Peter W.: "Molecular Biology of the Cell", 5th Edition, CRC Press, India.
2	Anton Moser., The Principles of Bioprocess Technology, Springer New York, NY
3	Paul D.: "Physics in Biology and Medicine", 3rd Edition, Academic Press, USA.
4	Colin R. Bjorn K. : "Basic Biotechnology", 3rd Edition, Cambridge University Press, UK
Syllabus for Unit Test	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

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ENZYME TECHNOLOGY

Teaching Scheme		Examination Scheme		Credits Allotted	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: Biology, Chemistry, and Bioprocess Principles

Course Outcomes

After completion of the course students would be able to:

1	Learn mechanism of enzymatic processes.
2	Learn the kinetics of enzyme reaction.
3	Learn enzyme immobilization.
4	Analyze purification of enzymes from natural sources.
5	Understand production of enzymes from different routes.
6	Learn design of bioreactor for enzymatic reactions.

Topics covered

UNIT-I	**Introduction to Enzymes** Classification of enzymes – Mechanisms of enzyme action – Concept of active site and energetics of enzyme substrate complex formation – Specificity of enzyme action –Principles of catalysis	**(06 Hours)**
UNIT-II	**Kinetics of Enzyme Action** Kinetics of single substrate reactions; estimation of Michelis-Menten parameters – Multisubstrate reactions – Mechanisms and kinetics – Turnover number – Types of inhibition and models for substrate and product, Monod Changeux Wyman model, pH and temperature effect on enzymes & deactivation kinetics	**(06 Hours)**

UNIT-III	**Enzyme Immobilization** Physical and chemical techniques for enzyme immobilization – Adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding and suitable examples – Advantages and disadvantages	**(06 Hours)**
UNIT-IV	**Purification and Characterization of Enzymes from Natural Sources** Production and purification of crude enzyme extracts from plant, animal and microbial sources – Methods of characterization of enzymes – Development of enzymatic assays	**(06 Hours)**
UNIT-V	**Production of Enzymes and Applications of Enzymes** Production of Industrial Enzymes, amylase, glucose isomerases, asparaginase, proteases, lipases, penicillin acylase, Enzymes in organic synthesis – esters, amide, peptide – Modified and Artificial Enzymes	**(06 Hours)**
UNIT-VI	**Bioreactor Consideration in Enzyme Systems** Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors	**(06 Hours)**

Project Based Learning	
1	List out all the principles of enzymatic reactions
2	Find out different types of enzymes used in daily life.
3	Search out some industries related to enzyme production.
4	Write a technical report on your visit to an enzyme production industry.
5	Give fifteen minutes presentation (seminar) on particular topic and prepare a report.
6	Group discussion on merits and de-merits of use of Enzyme technology in medical field.

Term Work: The term-work shall include a record of at least six experiments, related to each syllabus unit, conducted by the student.

1	Enzyme kinetics – Determination of Michaelis Menten parameters
2	Enzyme activity – Effect of Temperature and Deactivation Kinetics
3	Enzyme activity – Effect of pH
4	Enzyme inhibition kinetics
5	Qualitative study of enzyme activity
6	Identification of enzymes in different sources

7	Isolation of œ Amylase from different sources
8	Determination of œ Amylase Enzyme activity
9	Specific activity of œ Amylase
10	Determination of K_m and V_{max} of œ Amylase
Text Books/Reference Books	
1	Bruce A. Alexander J. Julian L., Martin R. Keith R. and Peter W.: "Molecular Biology of the Cell", 5th Edition, CRC Press, India.
2	Anton Moser., "The Principles of Bioprocess Technology", Springer New York, NY
3	Dugas, Hermann " Bioorganic Chemistry : A Chemical Approach to Enzyme Action" 3rd Edition, Springer, 2003.
4	Bhatt S.M. "Enzymology and Enzyme Technology", S. Chand Publishing, 2022
5	Khan M.Y., Khan F., "Principles of enzyme technology", PHI Learning Pvt. Ltd.
6	Karl-Erich J., Andreas L., Christoph S., "Introduction to Enzyme Technology", Springer Cham, 2024
Syllabus for Unit Test	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

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COLLEGE OF ENGINEERING, PUNE

B. Tech. (Chemical) (2023 Course)

Minor Degree Programme II: Waste Water Treatment

Sr. No.	Category	Semester	Course	Teaching Scheme			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1	MI	III	Waste Water Treatment: Scope and Significance	3	2	-	60	40	25	-	25	150	3	1	-	4
2	MI	IV	Waste Water Treatment: Biological Processes	3	2	-	60	40	25	-	25	150	3	1	-	4
3	MI	V	Waste Water Treatment: Advanced Oxidation Processes	3	2	-	60	40	25	25	-	150	3	1	-	4
4	MI	VI	Waste Water Treatment: Membrane Processes	3	2	-	60	40	25	25	-	150	3	1	-	4
5	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
Total				**12**	**12**	**-**	**240**	**160**	**150**	**50**	**100**	**700**	**12**	**08**	**-**	**20**

WASTE WATER TREATMENT: SCOPE AND SIGNIFICANCE					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Practical	: 25 Marks		
		Total	: 150 Marks		
Course Pre-requisites: Basic Sciences, Transport processes, and Thermodynamics					
Course Outcomes					
After completion of the course students would be able to:					
1	Learn the significance of study of Environmental engineering				
2	Learn the basics of conventional wastewater treatment				
3	Analyze principles of equipment used for wastewater treatment				
4	Learn different wastewater treatment techniques				
5	Learn Anaerobic treatment methods				
6	Understand industrial standards for effluent disposal and selection of suitable treatment				
Topics covered					
UNIT-I	**Introduction** Significance of study of Environmental engineering, Global scenario – Pollution aspect in Chemical process industry, Water treatment, Drinking water characteristics, Wastewater treatment, Characteristics of wastewater, Analytical methods , Concept of zero discharge system			**(06 Hours)**	
UNIT-II	**Conventional wastewater treatment methods** Effluent standards, Primary treatment – Primary sedimentation, Grit chamber, Flocculation; Secondary Treatment- Kinetics of growth and food utilization, Culture system application, Activated sludge process, Trickling filters, Rotating biological contactors, Fluidized Aerobic Bioreactor,			**(06 Hours)**	

UNIT-III	**Equipment used in wastewater treatments** Selection of equipment, sizing of equipment, Clarifier, Clari-flocculator, Bioreactor, Diffuser system	**(06 Hours)**
UNIT-IV	**Anaerobic treatment methods** UASB- Up-flow Anaerobic Sludge Blanket Reactor, System details-construction and working, Pros and cons of Anaerobic treatment, Start-up of UASB and problems encountered in it, Industrial applications	**(06 Hours)**
UNIT-V	**Environmental impact of effluent** Environmental impact of effluent, industrial standards for disposal of effluent, Effective treatment methods adopted for textile effluent (Case study)	**(06 Hours)**
UNIT-VI	**Environmental Laws** Significance of CETP- Central Effluent Treatment Plant, Various industrial Pollution Control Acts, Various Industry Pollution Acts	**(06 Hours)**

Project Based Learning	
1.	Learn to acclimatize microorganisms for wastewater Treatment
2.	Analyze Application of Bioreactor for the treatment of liquid Bio- medical waste
3.	Analyze Aerobic treatment methods for Textile effluent
4.	Analyze Aerobic treatment for Dairy wastewater
5.	Illustration of Anaerobic treatment application in Sugar Industry
6.	Learn the concept of Bioreactor design
7.	Analyze application of engineered microorganisms in wastewater treatment
8.	Analyze application of Fluidized Aerobic Bioreactor for the treatment of liquid biomedical waste.
9.	Model making of Effluent Treatment Plant

Term Work: The term-work shall include a record of at least six experiments, related to each syllabus unit, conducted by the student.

1	Identification of microorganisms according to structure of bacterial cell using microscope
2	Study of wastewater characteristics

3	Study of performance of Bioreactor
4	Analysis of Textile effluent
5	Biological treatment of Textile effluent
6	Anaerobic treatment of effluent
7	Application of engineered microorganisms for hazardous waste treatment
8	Effect of pH on biological treatment
9	Effect of DO in performance of Bioreactor
10	Disinfection of water
Text Books/Reference Books	
1	"Environmental Engineering, A Design Approach," A.P. Sincero, G.A. Sincero, Prentice Hall India.
2	"Advances in Wastewater Treatment", Vol I, R. K. Trivedy, Global Science, India
3	"Wastewater Engineering Treatment and Resource Recovery" Fifth Edition Metcalf & Eddy
4	Colin R. Bjorn K. "Basic Biotechnology", 3rd Edition, Cambridge University Press, UK
Syllabus for Unit Test	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

WASTE WATER TREATMENT: BIOLOGICAL PROCESSES					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours/Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150Marks		

Course Pre-requisites: Biology, Chemistry, and Reaction Kinetics

Course Outcomes

After completion of the course students will be able to

1	Learn the principles of Biological Wastewater Treatment.
2	Analyze Suspended Growth Processes.
3	Learn the mechanism of attached growth processes.
4	Study of Aerobic and anaerobic Biological Oxidation Process.
5	Learn the removal processes for Phosphorus Removal, nitrogen removal.
6	Analyze combination of biological processes.

Topics Covered

UNIT-I	**Overview of Biological Wastewater Treatment** Objectives of Biological Treatment, Role of Microorganisms in Wastewater Treatment, Types of Biological Processes for Wastewater Treatment, Composition and Classification, of Microorganisms, Role of Microorganisms, Introduction to Microbial Metabolism, Carbon and Energy Sources for Microbial Growth, Nutrient and Growth Factor requirement.	**(06 Hours)**
UNIT-II	**Suspended Growth Processes**	**(06 Hours)**

	Suspended Growth Treatment Processes, Biomass Mass Balance, Substrate Mass Balance, Mixed Liquor Solids Concentration, and Solids Production, Oxygen Requirements, Anaerobic Suspended Growth Processes, Design and Operating Parameters, Process Performance and Stability, Process Design Considerations, Operational Problems	
UNIT-III	**Attached Growth Processes** Substrate Removal in Attached Growth Treatment Processes, Mechanism of the process, substrate Flux in Biofilms, Substrate Mass Balance for Biofilm, Substrate Flux Limitations, Process Design Considerations, Operational Problems	**(06 Hours)**
UNIT-IV	**Aerobic and anaerobic Biological Oxidation Process** Stoichiometry of Biological Oxidation, Growth Kinetics, Design and Operating Parameters, Process Performance and Stability, Process Design Considerations, Operational Problems, Anoxic/Aerobic Process Design	**(06 Hours)**
UNIT-V	**Processes for Removal and Nitrification** Biological Phosphorus Removal, Process Design Considerations, Stoichiometry of biological phosphorus removal, Processes for biological nitrogen removal, Process Design Considerations, Operational Problems.	**(06 Hours)**
UNIT-VI	**Combined Biological Treatment Processes** Trickling Filters, Rotating Biological Contactors, Combined Aerobic Treatment Processes, Upflow Packed-Bed Attached Growth Reactor, Upflow Attached Growth Anaerobic, Fluidized-Bed bioreactor, Lagoon Processes	**(06 Hours)**

Project Based Learning	
1.	Visit to any wastewater treatment plant and specify the biological method used in industry.
2.	Design the activated sludge process for any industrial effluent
3.	Write a report on concept of zero discharge and its significance
4.	Demonstrate the applications of biological processes in wastewater treatment
5.	Prepare power point presentation on aerobic and anaerobic processes.

6.	Prepare report on literature survey on various biological technologies used in textile industry wastewater.
Term work: The term-work shall include a record of at least six experiments, related to each syllabus unit, conducted by the student.	
1.	To estimate the characteristics of wastewater
2.	To develop a culture in laminar flow system
3.	To study Aerobic oxidation process for given sample
4.	To estimate BOD for a given sample
5.	To estimate COD for a given sample
6.	To estimate Dissolved oxygen for a given sample
7.	To estimate the kinetics of the biological process for wastewater treatment
8.	To estimate nitrogen content from a given sample
9.	To estimate phosphorous removal from a given sample
Text Books/Reference Books	
1	Benefield R.D., and Randal C.W., (1980), "Biological Process Design for Wastewater Treatment", Prentice Hall, Englewood Chiffs, New Jersey
2	Metcalf and Eddy Inc., (2003), "Wastewater Engineering - Treatment and Reuse", 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3	Lee C.C., and Lin S.D., (1999), "Handbook of Environmental Engineering Calculations", McGraw Hill, New York
4	Fair, G.M., Geyer J.C and Okun, (1969) "Water and Wastewater Engineering" Vol II, John Wiley Publications
Syllabus for Unit Test	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

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B. Tech. (Civil) (2023 Course)

Minor Degree Programme I: Integrated Building System

Sr. No	Category	Semester	Name of Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1	MI	III	Interior Design and Landscaping	3	2	-	60	40	25	-	25	150	3	1	-	**4**
2	MI	IV	Building Automation	3	2	-	60	40	25	-	25	150	3	1	-	**4**
3	MI	V	Electrical and Plumbing	3	2	-	60	40	25	-	25	150	3	1	-	**4**
4	MI	VI	Building Information Modelling in Architecture and Construction	3	2	-	60	40	25	-	25	150	3	1	-	**4**
5	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	**4**
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

INTERIOR DESIGN AND LANDSCAPING					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: Building Drawing, Building Planning, Auto Cad 2D & 3D, SketchUp

Course Outcomes

After completion of the course students would be able to:

1	Interpret elements and principals of interior design.
2	Identify aspects of spatial planning and furniture design.
3	Utilize principles of lighting and acoustics in interior design.
4	Examine principles of landscape architecture.
5	Interpret principles of planting design and basic horticulture.
6	Examine principles of site planning and sustainable architecture

Topics covered

UNIT-I	**Introduction to Interior Design Concepts:** Elements of Interior Design: Space, Line, Forms, Texture, Color, Light, Pattern. Principles of Interior Design: Balance, Rhythm, Emphasis, Contrast, Harmony, Proportion.	**(06 Hours)**
UNIT-II	**Spatial Planning and Furniture Design:** Aspects of Spatial Planning: Functionality, Traffic Flow, Furniture Layout, Zone Planning, Proximity and Accessibility, Flexibility. Aspects of Furniture Design: Form and Structure, Materials, Ergonomics, Aesthetics, Functionality, (Minimum Dimensions of all elements), Sustainability, Innovation	**(06 Hours)**
UNIT-III	**Lighting and Acoustics in Interior Spaces:** Natural Lighting Design: Daylight Analysis, Daylight Harvesting, Window	**(06 Hours)**

	Placement, Light Control. **Artificial Lighting Design:** Task Lighting, Ambient Lighting, Accent Lighting, Lighting Fixtures, Color Temperature. Acoustics and Sound Control in Interiors: Understanding Acoustics: Reflection, Absorption, Transmission, Diffusion, Acoustic Design Solutions, Soundproofing, Ceiling and Wall Treatments, Flooring Solutions, Furniture Placement. **Noise Control in Open Spaces:** Open Office Layouts, Public Spaces.	
UNIT-IV	**Introduction to Landscape Design:** History and Evolution of Landscape Design: Ancient Civilizations, Renaissance Gardens, 18th and 19th Century, Modern and Contemporary Landscape Design. Principles of Landscape Architecture: Unity, Balance, Hierarchy, Scale and Proportion, Rhythm, Focalization, Transition, Sustainability, Functionality, Aesthetics, Cultural and Social Considerations	**(06 Hours)**
UNIT-V	**Planting Design and Horticulture:** Site Analysis, Plant Classification, Plant Selection Criteria, Biodiversity, Landscape Planting Plans, Microclimates. Basic Horticultural Practices: Soil Preparation, Planting Procedures, Watering and Irrigation, Fertilization, Pruning and Maintenance, Pest and Disease Management, Seasonal Care, Plant Health, and Sustainability.	**(06 Hours)**
UNIT-VI	**Site Planning and Sustainable Landscapes:** Site Evaluation, Climate and Microclimates, Solar Orientation, Historical and Cultural Analysis, User Needs and Preferences, Regulatory Requirements: Sustainable Landscaping Techniques and Materials: Water Conservation, Native and Adapted Plants, Soil Health, Permeable Surfaces, Energy-Efficient Lighting, Biodiversity, Green Infrastructure, Recycled and Reclaimed Materials, Maintenance Practices, Education and Outreach:	**(06 Hours)**
Project Based Learning: ANYONE based on following topics but not limited to-		
1	Adaptive Design for Special Needs	
2	Coworking Space Design	
3	Retail Store Redesign.	
4	Hospitality Suite Design	
5	Tiny House Interior Design	

6	Virtual Reality (VR) Showroom
7	Health and Wellness Center Design
8	Cultural Fusion in Interior Design
9	Community Garden Project
10	Outdoor Learning Space Design
11	Drought-Tolerant Landscape Design
12	Therapeutic Garden Design
13	Urban Rooftop Garden
14	Public Park Revitalization
15	Eco-Friendly Residential Landscape
Term Work: The term-work shall consist of Minimum **Eight Assignments** from list below.	
1	Design Concept Presentation
2	Space Planning Project
3	Material and Finish Board
4	Green Design Project
5	Historical Design Analysis
6	Client Profile and Presentation
7	Budget-Friendly Design Challenge
8	Retail Space Design
9	Cultural Fusion Project
10	Use of AI Tools
11	Site Analysis and Assessment
12	Planting Design Portfolio
13	Hardscape Design Project
14	Sustainable Landscape Design
15	Community Park Redesign
16	Seasonal Garden Planning.
17	Roof Garden Design
18	Water Feature Integration
19	Digital Design Presentation.
20	Heritage Garden Project.
Text Books/Reference Books	

1	M. Pratap Rao, “Interior Design Principles and Practice”, Standard Publishers and Distributors Pvt. Ltd. Dec. 2020 Edition.
2	Francis D. K. Ching and Corky Binggeli, “Interior Design Illustrated”, Wiley Publishers, 4th Edition March 2018.
3	Joseph DeChiara, Julius Panero, and Martin Zelnik, “Time-Saver Standards for Interior Design and Space Planning” Mc Graw Hill, 2nd Edition October 2011.
4	Nina M. Giglio (Author), Dennis J. Hall, “Architectural Graphic Standards for Residential Construction" John Wiley and Sons, May 2010.
5	Tim Waterman, “The Fundamentals of Landscape Architecture", Bloomsbury Academic Publishers. May 2015
6	Charles W. Harris, Nicholas T. Dines, and Kyle D. Brown., “Time-Saver Standards for Landscape Architecture" Mc Graw Hill Publications May 1998
7	National Building Code of India 2016 (NBC 2016) SP:7, Volume1 & 2
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BUILDING AUTOMATION					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: Fundamentals of Civil Engineering, Building Construction and Materials, Building Planning and Design

Course Outcomes

After completion of the course students would be able to:

1	Analyse current philosophy, technology, terminology, and practices used in building automation
2	Identify scope of automation in different functional systems in buildings
3	Decide the type of sensors and actuators for the automation.
4	Analyze functioning of automation systems in buildings
5	Evaluate energy management and communication for efficient Building Management System
6	Evaluate effect of automation in building

Topics covered

UNIT-I	**Introduction to Building Automation:** Definition and significance, Integration with Civil Engineering, Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.	**(06 Hours)**
UNIT-II	**Functional Systems in Building and Scope for automation:** Different functional systems in buildings like load transfer mechanism, movement system, lightening system, ventilation system, water supply system, sewage system, electrical power system, parking management system, Scope of automation in these system and their integration, Role of different engineering disciplines and co-ordination.	**(06 Hours)**

UNIT-III	**Sensors, Actuators and Control Systems:** Types of sensors (temperature, humidity, occupancy, etc.), Actuators and their applications, Calibration and interfacing, Basics of control theory, PID controllers, Feedback and feedforward control	**(06 Hours)**
UNIT-IV	**Automation Systems in Buildings:** Functioning of various Automation Systems in Buildings like- Structural health monitoring, Access control system, Movement system, Fire Alarm System, Heat Ventilation and Air Conditioning system, Plumbing system, lightening system, etc. Selection of sensors, actuators and integration of control system.	**(06 Hours)**
UNIT-V	**Energy Management System:** American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Symbols Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building Leadership in Energy and Environmental Design (LEED) Concept & Examples.	**(06 Hours)**
UNIT-VI	**Case Studies on building automation:** Real-world examples of successful building automation projects, Analysis of the impact on energy consumption and occupant comfort	**(06 Hours)**
Project Based Learning: ANYONE based on following topics but not limited to-		
1	Draw architecture of HVAC system, BMS system	
2	Elaborate concept of Green building in automation context	
3	Evaluate solutions for building management system provided by various companies	
4	Develop PLC Ladder for 3 floor lift control with diagram	
5	Develop automatic street lighting control using LDR	
6	Study and prepare report on different types of sensors.	
7	Study and prepare report on application of different types of sensors.	
8	Prepare report on cost of different sensors by market survey.	
9	Prepare report on benefits and limitations of automation system.	
10	Prepare working model on thermal sensor.	
11	Prepare working model on light sensor.	
12	Prepare working model on motion sensor.	
13	Prepare working model on touch sensor.	
14	Present case study on automation in residential building.	
15	Present case study on automation in public building.	

Term Work: The term-work shall consist of Minimum **Eight Assignments** from list below.	
1	To Draw different ASHRAE symbols
2	To perform Illumination Control with different circuits.
3	To develop an Automatic Overhead Tank Filling System
4	To study about Heating Ventilation & Air-Condition System (HVAC).
5	To study about Closed Circuit Television (CCTV).
6	To study & perform Fire Detector & Fire Alarm System
7	To develop a VI screen for monitoring alarm annunciator system using LabVIEW.
8	To Elaborate concept of Green building in automation context
9	To create an application for building automation
10	To Evaluate solutions for building management system provided by various companies.
11	To study &demonstration of Air conditioning System
12	To study &demonstration of light control System
13	To study &demonstration of access control system
14	To study &demonstration of integrated building system.
Text Books/Reference Books	
1	"Building Automation: Communication systems with EIB/KNX, LON and BACnet" by Hermann Merz
2	"Building Automation: Control Devices and Applications" by In Partnership with NCCER
3	"Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance" by Lal Jayamaha and Peter Herzog
	Online Resources
1	http://nptel.ac.in/video.php
2	https://buildingsolutions.honeywell.com/enUS/Pages/default.aspx
3	http://www.isa.org
4	http://www.controleng.com
5	http://www.schneider electric.com/b2b/en/solutions/system/s1/buildings-systems.jsp
6	http://www.automation.siemens.com/
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BHARATI VIDYAPEETH

(DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (Civil) (2023 Course)

Minor Degree Programme II : Green Infrastructure

Sr. No	Category	Semester	Name of Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1	MI	III	Green Construction Practices	3	2	-	60	40	25	-	25	150	3	1	-	**4**
2	MI	IV	Sustainable Transportation System	3	2	-	60	40	25	-	25	150	3	1	-	**4**
3	MI	V	Planning of Smart Cities	3	2	-	60	40	25	-	25	150	3	1	-	**4**
4	MI	VI	Environmental Management System	3	2	-	60	40	25	-	25	150	3	1	-	**4**
5	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	**4**
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

GREEN CONSTRUCTION PRACTICES					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: Environmental Science, Construction Technology and Materials

Course Outcomes

After completion of the course students would be able to:

1	Define the key principles, concepts, and terminology related to green building and sustainability.
2	Apply sustainable design principles, including site selection, passive design, and integr design processes, to create environmentally friendly building plans
3	*i*dentify and select sustainable building materials and construction methods while considering life cycle analysis and waste reduction
4	Analyze energy-efficient building strategies, and Assess and Evaluate water conservation techniques, such as grey water recycling, rainwater harvesting and efficient plumbing systems
5	Optimize indoor air quality, lighting, acoustics, and thermal comfort to enhance occupant well-being
6	Understand and navigate green building certification systems

Topics covered

UNIT-I	**Introduction to Green Building** Overview of Green Building Concept, Historical development of sustainable architecture, importance of sustainable construction, Current Trends in Green Building	**(06 Hours)**
UNIT-II	**Sustainable Site Planning and R concept (Reduce, Reuse & Recycle)** Site selection and orientation, sustainable landscaping and, Green urban planning and green infrastructure	**(06 Hours)**

	Waste management during construction as well as post-occupancy Opportunities for reuse of existing building elements & salvaged materials Selection of eco-friendly building materials	
UNIT-III	**Sustainable Building Materials** Selection of Eco-Friendly Materials, Low impact materials and their application, Evaluating the life cycle of building materials, Recycling and Reuse	**(06 Hours)**
UNIT-IV	**Energy Efficiency and Water Efficiency** Principle of energy efficient design, Renewable energy source in building, Energy efficient Heating, Ventilation and Air Conditioning (HVAC) System and lightning. Water Conservation in Buildings, Grey water and Rainwater Harvesting, Water Efficiency Analysis	**(06 Hours)**
UNIT-V	**Indoor Environmental quality R concept (Reduce, Reuse & Recycle) and Green Contracts** Indoor air quality management during construction & post-occupancy Strategies for effective ventilation, day lighting & views, Enhancement of thermal comfort by design, Use of low emitting interior materials, Indoor pollution source control **Green Contracts** Introduction to Green Contracts, Principles of Contract Law, Sustainable Procurement Contracts, Renewable Energy Contracts, Environmental performance contracts Dispute Resolution in Green Contracts**.**	**(06 Hours)**
UNIT-VI	**Certification and Rating systems** Certification systems- Green Rating for Integrated Habitat Assessment (GRIHA), Building Research Establishment Environmental Assessment Method (BREEAM) and Leadership in Energy and Environmental Design (LEED), case studies	**(06 Hours)**
Project Based Learning: ANYONE based on following topics but not limited to-		
1	Conduct research on the concept of green building. Explore its definition, objectives, and key principles. Identify the primary goals and objectives of green building practices	
2	Evaluate the benefits and challenges associated with green building practices. Discuss how green building contributes to environmental sustainability, human health, and economic viability. Analyze the challenges faced in implementing green building techniques and strategies.	
3	Case Study Analysis: Select a real-life construction project that exemplifies sustainable site planning principles (e.g., low-impact development, green infrastructure, etc.). Analyze the project's site planning strategies, environmental considerations, and overall sustainability	

	outcomes.
4	Site Design Proposal: Develop a conceptual site design proposal for a hypothetical construction project. Incorporate sustainable site planning principles and strategies into your design, emphasizing features such as storm water management, native landscaping, habitat preservation, and energy-efficient site infrastructure.
5	Application of the R Concept: Propose strategies for integrating the R concept into construction projects. Identify specific opportunities for waste reduction, material reuse, and resource recycling throughout the project lifecycle, from design and construction to operation and maintenance.
6	Sustainable Material Investigation: Research and compile a list of sustainable materials commonly used in green construction. Compare their costs, availability, and environmental impact
7	Energy Efficiency Assessment: Conduct an energy audit of a building and propose strategies for improving energy efficiency through green construction techniques such as better insulation, efficient HVAC systems, and renewable energy integration.
8	Presentation: Prepare a visual presentation or design board showcasing your IEQ enhancement proposal. Clearly communicate the key features, strategies, and benefits of your design.
9	Proposal document for enhancing indoor environmental quality in a hypothetical building project.
10	Visual presentation or design board highlighting the key features of the IEQ enhancement proposal.
11	Case Study Analysis: Analyze a real-life construction project that incorporated green practices. Evaluate its success, challenges faced, and lessons learned.
12	Provide a rationale for your design choices, highlighting the potential benefits of enhanced indoor environmental quality for building occupants and stakeholders.
13	LEED Certification Study: Study the LEED (Leadership in Energy and Environmental Design) certification process and its requirements. Develop a hypothetical plan for a building to achieve LEED certification, considering various green construction practices.
14	Waste Management Plan Development: Create a waste management plan for a construction project, focusing on reducing, reusing, and recycling materials to minimize environmental impact.
15	Literature review on Research Paper: Write Literature review on a research paper on the

	latest trends and innovations in green construction practices, focusing on their environmental impact and benefits(minimum five research paper)
Term Work: The term-work shall consist of Minimum **Eight Assignments** from list below.	
1	Develop a water management plan for a site
2	Integrate geographical information system (GIS) data with R to analyse spatial patterns and relationships in environmental data.
3	Conduct a life cycle analysis of traditional building materials versus sustainable alternatives. Compare factors such as extraction, manufacturing, transportation, installation, use, and end-of-life considerations.
4	Design and construct a small-scale project using recycled or salvaged materials. This could include furniture, interior decor, or even a small structure.
5	Explore and experiment with natural building techniques such as adobe, cob, or straw bale construction. Build a small-scale model or structure using one of these methods.
6	Design and build a green roof using sustainable materials. Discuss the benefits of green roofs in terms of energy efficiency, stormwater management, and biodiversity.
7	Research and present innovative sustainable building materials that are currently in development or gaining popularity in the industry. Discuss their potential applications and benefits.
8	Design a water-efficient landscape, incorporating native plants, mulching, and efficient irrigation practices. Consider the use of drought-tolerant species.
9	Simulate the process of obtaining LEED certification with a focus on water efficiency. Evaluate the use of water-efficient fixtures and landscaping practices.
10	Conduct a water audit for a commercial building, identifying areas of water waste and proposing efficiency improvements.
Textbooks/Reference Books	
1	Er. M. K. Soni **"Eco-Friendly Building Materials: A Conceptual Approach"** Publisher: New Age International Pvt Ltd Publishers 2013
2	G. B. Menon "Green Building: Guidebook for Sustainable Architecture" Publisher: TERI Press 2014
3	Sangeeta Bagga Mehta Green Architrcture: Design for a Sustainable Future Publisher: Rupa Publications 2015

4	Abe Kruger and Carl Seville "Green Building: Principles and Practices in Residential Construction" published by Pearson, 1st edition,2017.
5	"LEED Reference Guide for Building Design and Construction" by the U.S.Green Building Council (USGBC), 4th edition, 2022.
6	Jerry Yudelson "The Green Building Revolution" published by New Society Publishers, 1st edition 2022.
7	Lisa M. Tucker "Sustainable Building Systems and Construction for Designers" published by Fairchild Books, 2022.
8	Shalini Sharma Environmental Contracts and Corporate Governance: A Study of Environmental Accountability and Reporting in India "Publisher: Springer 2016
9	Green Building and LEED Core Concepts Guide" by USGBC,3rdedition2022.
	Online Resources
1	https://safetyculture.com/topics/green-building/
2	https://archive.epa.gov/greenbuilding/web/html/about.html
3	https://www.mdpi.com/2071-1050/14/21/14393
4	https://mpra.ub.uni-muenchen.de/76588/1/MPRA_paper_76588.pdf
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

SUSTAINABLE TRANSPORTATION SYSTEM					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: Fundamentals of Civil Engineering

Course Outcomes

After completion of the course students would be able to:

1	Understand concept of sustainable transportation system.
2	Examine the principles of sustainable transportation planning.
3	Learn the latest transportation technologies.
4	Know the modes for sustainable urban mobility.
5	Understand the Environmental and social Impact of Transportation.
6	Learn the policy and regulation in sustainable Transportation.

Topics covered

UNIT-I	**Introduction to sustainable Transportation Systems** Overview of transportation systems, Definition and importance of sustainable transportation, Historical perspective and evolution of transportation, Key challenges and issues in the current transportation systems.	**(06 Hours)**
UNIT-II	**Principles of Sustainable Transportation Planning** Sustainable Transportation Planningframeworks, Integration of land use and transportation, Multi-modal Transportation Planning,Public participation in transportation planning, Innovative practices for promotion of public transport facility.	**(06 Hours)**
UNIT-III	**Transportation Technologies** Electric vehicles and their infrastructure, Biofuels and other alternative fuels, Hydrogen/ Green Hydrogen, Emerging technologies (e.g., autonomous vehicles, hyperloop), Role of ICT in Transportation.	**(06 Hours)**

UNIT-IV	**Sustainable Urban Mobility** Urbanization and its impact on transportation, Transit-oriented development, Modes of Urban Mass Transport, Non-motorized transportation (cycling, walking), Green infrastructure and urban design, Last mile Connectivity.	**(06 Hours)**
UNIT-V	**Environmental and Social Impacts of Transportation** Greenhouse gas emissions and climate change, Air and noise pollution from transportation, Net Zero Concept, Health impacts of transportation choices, Strategies to mitigate negative impacts.	**(06 Hours)**
UNIT-VI	**Policy and Regulation in Sustainable Transportation** National urban Transport Policy,Government incentives and regulations, Funding mechanisms for sustainable transportation projects, Role of private and public sectors in sustainable transportation, Future trends and challenges in sustainable transportation policy.	**(06 Hours)**

Project Based Learning: ANYONE based on following topics but not limited to-	
1	Develop a multimedia campaign (posters, social media, and short videos) to raise awareness about the importance of sustainable transportation.
2	Create an infographic illustrating the evolution of transportation systems, highlighting key milestones and shifts toward sustainability.
3	Propose and plan the implementation of a bike share program in a specific urban area.
4	Conduct a transportation survey within a community to understand commuting patterns and preferences, then propose sustainable solutions based on the findings.
5	Research and compare the environmental and economic impacts of different alternative fuels (biofuels, hydrogen, electric) for transportation.
6	Assess the walkability of a neighborhood and suggest improvements such as crosswalks, pedestrian-friendly zones, and green spaces.
7	Prepare a detailed case study report on a city with successful transit-oriented development and analyze the impact on mobility, accessibility, and quality of life.
8	Develop a proposal for incorporating green infrastructure and urban design elements in a specific urban area.
9	Launch a public awareness campaign focused on reducing emissions from transportation.
10	Produce a documentary exploring the environmental justice implications of transportation decisions.
11	Challenge individuals or communities to reduce their transportation-related carbon footprint over a specific period and track the results.

12	Create a proposal outlining a public-private partnership to fund and implement sustainable transportation projects, emphasizing mutual benefits for the government and private sector.
13	Create a proposal outlining a public-private partnership to fund and implement sustainable transportation projects, emphasizing mutual benefits for the government and private sector.
14	Develop a comprehensive handbook outlining sustainable transportation policies.
15	Organize a debate on future trends and challenges in sustainable transportation policy.
Term Work: The term-work shall consist of Minimum **Eight Assignments** from list below.	
1	Prepare a power point presentation on 'An overview of different transportation systems worldwide', emphasizing their sustainability challenges.
2	Prepare a power point presentation on 'The historical evolution of transportation systems', analyzing the influence of technological advancements on sustainability.
3	Prepare a Comparative Analysis of Sustainable Transportation Planning Frameworks, highlighting their strengths, weaknesses, and practical applications.
4	Prepare a report on 'Investigating the current state of electric vehicles (EVs), analyze infrastructure requirements, and propose strategies to promote widespread EV adoption'.
5	Prepare a report on 'A case study of a city's sustainable urban mobility initiatives, focusing on successful projects, challenges, and lessons learned'.
6	Choose a transportation project and perform a comprehensive environmental and social impact assessment, proposing mitigation measures for identified negative impacts.
7	Analyze the impact of existing transportation policies and regulations on sustainability, proposing recommendations for improvement or new policies.
8	Prepare a power point presentation on 'concept of multi-modal transportation planning, discussing its benefits, challenges, and real-world examples, and its contribution to sustainability.
9	Investigate the role of green infrastructure and urban design in promoting sustainable transportation, providing examples and discussing their impact on communities.
10	Prepare a power point presentation on 'emerging trends in sustainable transportation, including the impact of autonomous vehicles, smart cities, and innovative technologies on the future of transportation systems'.
Textbooks/Reference Books	
1	Hutchinson, B.G., Principles of Urban Transport Systems Planning, McGraw Hill, New York, 1974.

2	Ortuzar, J. and Willumsen, L.G., Modelling Transport, Wiley, Chinchestor, 1994.
3	Oppenheim, N., Urban Travel Demand Modeling: From Individual Choices to General Equilibrium, Wiley, New York, 1995.
4	Thomas, R., Traffic Assignment Techniques, Avebury Technical, Aldershot, 1991.
5	Taniguchi, E., Thompson, R.G., Yamada, T. and Van Duin, R., City Logistics - Network Modelling and Intelligent Transport Systems, Elsevier, Pergamon, Oxford, 2001.
6	Bruton, M.J., Introduction to Transportation Planning, Huchinson, January 1970
7	Hutchinson, London, 1985. Dickey, J.W., Metropolitan Transportation Planning, Tata McGraw Hill, New Delhi, 1975.
8	"Sustainable Transportation: Problems and Solutions" by William R. Black
9	"Transportation Planning Handbook" by ITE (Institute of Transportation Engineers)
10	"Introduction to Sustainable Transportation" by Preston L. Schiller, Eric C. Bruun, and Jeffrey R. Kenworthy
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BHARATI VIDYAPEETH

(DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (Computer Engineering) (2023 Course)

Minor Degree Programme I : Artificial Intelligence & Data Science

Sr. No	Category	Semester	Name of the Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Soft computing	3	2	-	60	40	25	-	25	150	3	1	-	4
2.	MI	IV	Artificial Intelligence	3	2	-	60	40	25		25	150	3	1	-	4
3.	MI	V	Advanced Machine Learning	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	MI	VI	Data Science	3	2	-	60	40	25	-	25	150	3	1	-	4
5.	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

SOFT COMPUTING					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: Linear Algebra & Calculus, Introduction to Programming

Course Outcomes

After completion of the course students would be able to:

1	Explain the fundamental concepts and principles of Soft Computing, including fuzzy logic, neural networks, and evolutionary algorithms
2	Implement supervised artificial neural networks for pattern recognition, classification, regression, understanding their architecture and learning algorithms
3	Implement unsupervised artificial neural networks for data clustering and classification
4	Solve optimization problems using genetic algorithms
5	Utilize evolutionary algorithms, such PSO, ACO, ABC, DE, HS, SA, GWO, BAT, CS, FPA, WO, FA for optimization and search problems
6	Apply fuzzy logic techniques for decision-making, control, and pattern recognition tasks in various engineering and scientific domains

Topics covered

UNIT-I	**Introduction to Soft Computing** Introduction to Soft Computing paradigms and their significance. Comparison between Soft Computing and traditional computing approaches. Overview of fuzzy logic, neural networks, evolutionary algorithms, and other Soft Computing techniques. Characteristics and advantages of Soft Computing techniques. Real-world applications of Soft Computing in engineering and scientific domains.	**(06 Hours)**
UNIT-II	**Artificial Neural Networks-I**	**(06 Hours)**

	Biological neuron, Artificial neuron model, concept of bias and threshold, Mc Culloch-Pits Neuron Model, implementation of logical AND, OR and XOR functions, Topologies of neural networks, learning paradigms: supervised, unsupervised, reinforcement, Linear neuron model: concept of error energy, gradient descent algorithm and application of linear neuron for linear regression, Activation functions: binary , bipolar (linear, signum, log sigmoid, tan-sigmoid) ,Learning mechanisms: Hebbian, Delta Rule, Perceptron and its limitations, Multilayer perceptron (MLP) and backpropagation algorithm, Application of MLP for classification and regression	
UNIT-III	**Artificial Neural Networks-II** Self-organizing Feature Maps, k-means clustering, Learning vector quantization , Radial Basis Function networks: Cover's theorem, mapping functions(Gaussian, Multi-quadrics, Inverse multi-quadrics, Application of RBFN for classification and regression, Hopfield network, associative memories	**(06 Hours)**
UNIT-IV	**Evolutionary Algorithms- I** **Genetic Algorithms** Concept of genetic evolution, parent, child, chromosome, mutation from biological perspective, Comparison of Biological and GA Terminology , Robustness ,Non-integer Unknowns, Multi-parameter Problems, Mutation, Selection, Elitism ,Crossover, Initialization, Advanced Operators: Combinatorial Optimization, Locating Alternative Solutions using Niches and Species Constraints ,Multi-criteria Optimization Hybrid Algorithms, Alternative Selection Methods, Alternative Crossover Methods ,Considerations of Speed	**(06 Hours)**
UNIT-V	**Evolutionary Algorithms-II** Differential Evolution (DE), Evolutionary Strategies (ES), Genetic Programming (GP), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Simulated Annealing (SA), Harmony Search (HS), Artificial Bee Colony (ABC), Firefly Algorithm (FA), Cuckoo Search (CS),	**(06 Hours)**

	Bat Algorithm (BA), Grey Wolf Optimizer (GWO), Whale Optimization Algorithm (WOA), Flower Pollination Algorithm (FPA)	
UNIT-VI	**Fuzzy Logic** Concept of Fuzzy number, fuzzy set theory(continuous, discrete), Operations on fuzzy sets, Fuzzy member-ship functions , primary and composite linguistic terms, Concept of fuzzy relation, composition operation, Concept of fuzzy inference, Fuzzification and de-fuzzification, Mamdani inference rule, Sugeno inference rule.	**(06 Hours)**

Project Based Learning: The students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.

Term Work: The term work shall consist of record of minimum eight experiments performed by the student using MATLAB® or equivalent software:

1	Implement perceptron network for emulating the behaviour of AND, OR logic gates
2	Implement backpropagation algorithm for emulating XOR gate
3	Implement MLP for two class classification/regression
4	Implement k-means clustering algorithm
5	Implement RBFN for two class classification/regression
6	Implement a genetic algorithm for solving a simple optimization problem (e.g., Knapsack problem).
7	Implement PSO for solving as simple optimization problem
8	Implement ACO for solving optimization problem (e.g., Traveling Salesman Problem)
9	Implement a two input -one output FIS
10	Implement a simulated annealing algorithm for optimizing a non-linear function (e.g., Rosenbrock function).

Textbooks/Reference Books

1	"Soft Computing: Concepts and Applications" by N.P. Padhy, S.K. Dash, and M.M. Naik

2	Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Laurene Fausett, Pearson Education, Inc, 2008
3	Neural Networks-A comprehensive foundation, Simon Haykin, Prentice Hall International Inc., 1999
4	Fuzzy Logic With Engineering Applications, Third Edition, Timothy Ross, John Wiley & Sons, 2010
5	Genetic Algorithms in Search, Optimization, and Machine Learning, David Goldberg, Addison Wesley, 1989
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

ARTIFICIAL INTELLIGENCE					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: Discrete Mathematics, Data Structures and Algorithms, Any Programming Knowledge (Java, Python)

Course Outcomes

After completion of the course students would be able to:

1	Demonstrate the knowledge of fundamental concepts of Artificial Intelligence
2	Identify and apply appropriate search strategies for any AI problem
3	Explore knowledge reasoning and knowledge representation methods (for solving real world problems)
4	Illustrate the construction of learning and expert system
5	Correlate the appropriate methods of Game Theory to design AI applications
6	Apply the concept of deep learning and AI applications

Topics covered

UNIT-I	**Introduction to AI** Introduction to Artificial Intelligence, Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Risks and Benefits of AI, Intelligent Agents, Agents and Environments, Good Behavior: Concept of Rationality, Nature of Environments, Structure of Agents. IBM LegalMation : helps legal teams draft high-quality litigation work in minutes.	**(06 Hours)**

UNIT-II	**Problem-solving** Solving Problems by Searching, Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Search in Complex Environments, Local Search and Optimization Problems. Deep knowledge ventures: how this company uses " board management software "for making autonomous venture investment decisions.	(06 Hours)
UNIT-III	**Knowledge Representation** Knowledge and Reasoning: Logical Agents, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic Building a Knowledge Base: Propositional logic, first order Logic, situation calculus. Theorem Proving in First Order Logic, Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks. Probabilistic reasoning over time: time and uncertainty, hidden Markova models, Kalman filter, dynamic bayesian network, keeping track of many objects. Case Study: "IBM Watson: Revolutionizing Healthcare Diagnosis with Knowledge-Based Agents and First-Order Logic".	(06 Hours)
UNIT-IV	**Learning** Learning from examples: Overview of different forms of learning, Supervised learning, Unsupervised learning, Learning Decision Trees, regression and classification with linear model, SVM, Ensemble learning, Reinforcement learning. Artificial neural network.	(06 Hours)
UNIT-V	**Introduction To Game Theory** Game Theory, Optimal Decisions in Games, Heuristic Alpha–Beta Tree Search, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms, Constraint Satisfaction Problems (CSP), Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs. Case Study: IBM Deep Blue Chess engine.	(06 Hours)
UNIT-VI	**Recent and future trends in AI**	(06 Hours)

	Deep Learning: Introduction, why to go deep? Architecture of Deep Network, Restricted Boltzmann Machines, Deep belief Network, Tensor Flow, Deep Learning libraries, Deep Learning platform, The no, Caffe, Deep Learning Use Cases. Applications: Overview of Artificial Intelligence Domains, AI-Robotics, AI-Neural Networks, AI-IOT, Computer Vision in AI. Case Study: "Google's DeepMind: Advancements in Healthcare with AI", Text to Speech Conversion using APIs.	

Project Based Learning: The students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.

Term Work: The term work shall consist of record of minimum eight experiments performed by the student using any suitable programming language:

1	Identify and Implement heuristic and search strategy for Travelling Salesperson Problem
2	Implement n-queens problem using Hill-climbing / simulated annealing / A* algorithm etc.
3	Write a program for Water jug problem / Towers of Hanoi
4	Write a program for sorting algorithms using appropriate knowledge representation and reasoning Techniques.
5	Implement optical character recognition using ANN
6	To create a knowledge-based agent that uses propositional logic to solve a problem.
7	To implement a simple diagnostic system using Bayesian Networks.
8	To implement a backtracking search algorithm for solving CSPs.
9	To build and train a simple deep learning model using TensorFlow.
10	To implement a text-to-speech conversion system using available APIs.

Text Books/Reference Books

1	Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Third edition, Pearson, 2003, ISBN :10: 0136042597
2	Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1

3	Elaine Rich, Kevin Knight and Nair, “Artificial Intelligence”, TMH, ISBN-978-0-07-008770-5
4	Nilsson Nils J , “Artificial Intelligence: A new Synthesis”, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
5	Patrick Henry Winston, “Artificial Intelligence”, Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
6	Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BHARATI VIDYAPEETH

(DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (Computer Engineering) (2023 Course)

Minor Degree Programme II : Artificial Intelligence & Game Development

Sr. No	Category	Semester	Name of the Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	UI UX Design	3	2	-	60	40	25	-	25	150	3	1	-	4
2.	MI	IV	Game Theory	3	2	-	60	40	25	-	25	150	3	1	-	4
3.	MI	V	Knowledge Management System	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	MI	VI	AI algorithms and Game Development	3	2	-	60	40	25	-	25	150	3	1	-	4
5.	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

UI UX DESIGN					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites:

The students should have knowledge of basic knowledge of designing tools and languages like HTML, Java, etc.

Course Outcomes

After completion of the course students would be able to:

1	Identify User Interface (UI) design principles.
2	Apply Interactive Design process in real world applications.
3	Judge user research, solution conceptualization and validation as interwoven activities in the design and development lifecycle.
4	Infer the ability to constructively engage with the Design professionals they would work with in the future.
5	Understand user-centered design and usability engineering principles as they design a variety of software user interfaces.
6	Use prototyping methods to discover requirements and to evaluate design alternatives.

Topics covered

UNIT-I	**Introduction to UI** User interface design basic, relationship between UI and UX, Historical review of interface design, interface conventions, template vs contents, formal elements of interface design, UI design process.	**(06 Hours)**
UNIT-II	**Introduction to UX** UX basics, good and poor design, understanding your user, designing the experience, Elements of UX, Visual design principles, Functional layout, Introduction to interface.	**(06 Hours)**

UNIT-III	**UX Design Process** Types of Data in UX Design, Introduction and Definition on 6 Stages of Design Process, Heuristic Evaluation, Information Design and Data Visualization, Wire framing & Storyboarding, Elements and Widgets,	**(06 Hours)**
UNIT-IV	**UX Testing Process** Design Testing Methods and Techniques. Usability Testing – Types and Process, Various Prototyping Tools, How to prepare Usability Testing, How to understand & refine Usability Test Results?	**(06 Hours)**
UNIT-V	**UI/ UX Design Tools** User Study- Interviews, writing personas: user and device personas, User Context, Building Low Fidelity Wireframe and High-Fidelity Polished Wireframe Using wireframing Tools, Creating the working Prototype using Prototyping tools, Sharing and Exporting Design	**(06 Hours)**
UNIT-VI	**Cognitive Psychology in Design** Cognitive psychology principles guide design decisions, understanding how users perceive, process, and remember information informs design decisions, Hick's Law and Fitts' Law, Designing for short and long-term memory retention.	**(06 Hours)**

Project Based Learning	
1	Project Web Site and Brainstorming.
2	UI Critique.
3	Study the process of creating Graphically User Interface.
4	Study the implementation of GUI to different devices.
5	Develop the complete design process.
Term Work: The term work shall consist of record of minimum eight experiments performed by the student:	
1	Design a Logo for an E-Commerce app
2	Design an email that showcases a promotional offer of the e-commerce app
3	Create User Personas, User Stories, and Use Case Diagrams to de□ine a Problem Statement, Scope, and understand the problem.

4	User research: Document & Conduct user, market, product, and competitive research to find possible solutions.
5	Ideation: Create sketches and low-fidelity wireframes of the scoped solution.
6	Execution: Create High-Fidelity Mockups & Prototypes from the wireframes.
7	Figma basics: Creating basic responsive elements like buttons, input elements, etc. to understand frames, groups, layout, constraints, texts, vector, color palette.
8	Basic Clickable Prototyping using figma.
9	Create a Design System for an e-commerce app using Grid and Spacing, Typography, Color System, and UI elements like icons, images, buttons, Inputs, Cards, Search Bar, Lists, etc.
Text Books/Reference Books	
1	The Elements of User Experience: User-Centered Design for the Web and Beyond, Second Edition Jesse James Garrett, Pearson Education
2	The UX Book Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson and Pardha S. Pyla, Elsevier,
3	The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Third Edition Wilbert O. Galitz, Wiley Publishing,
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

GAME THEORY					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites:

OOP, probability, and statistics.

Course Outcomes

After completion of the course students would be able to:

1	Analyze the importance of artificial intelligence in games.
2	Identify different steering behavior in movement of characters.
3	Choose the partitioning techniques for designing games.
4	Examine decision making methods for games.
5	Design the strategies for games.
6	Select the appropriate design for AI games.

Topics covered

UNIT-I	**Introduction to Game AI** Role of AI in game design, Game AI interface (movement pathfinding, decision making) complexity (artificial stupidity, intelligent mistakes) game AI inputs, outputs and behaviors.	**(06 Hours)**
UNIT-II	**Movement Algorithms** Position matching, orientation matching, velocity and rotation matching, advanced movement delegation and combination, group movement.	**(06 Hours)**
UNIT-III	**Partitioning Algorithms** Structure of partitioning algorithms, A* and Heuristics, Abstraction schemes (Lifting and grounding, from partitioning to movement (the steering pipeline, obstacle and collision avoidance)	**(06 Hours)**

UNIT-IV	**Decision making algorithms** Structure of decision-making algorithms, decision trees, behavior trees, goal-oriented action planning.	**(06 Hours)**
UNIT-V	**Strategy Algorithms** Structure of strategy algorithm, blackboard, utility theory, Game playing (minmax, Alpha beta pruning), Monte-carlo tree search, coordinated actions (Multi-tier AI, Influence Maps).	**(06 Hours)**
UNIT-VI	**Procedural content generation** Structure of procedural content generators, pseudorandom number generation, content selection (L-systems, Grammers, randomness) content generation (parametric systems, search-based methods)	**(06 Hours)**

Project Based Learning	
1	Rock Paper Scissor
2	Gambit Play
3	Prisoner's Dilemma
4	The Battle of Sexes
5	The k-server problem

Term Work: The term work shall consist of record of minimum eight experiments performed by the student:	
1	Find the winner in nim-game.
2	Finding optimal move in Tic-Tac-Toe using Minimax Algorithm in Game Theory.
3	Find the player who will win by choosing a number in range [1, K] with sum total N.
4	Chessboard Pawn-Pawn game.
5	Coin game of two corners (Greedy Approach).
6	Josephus Problem | (Iterative Solution)
7	A Binary String Game.
8	Game of Chocolates | Wythoff's Game
9	Largest, odd divisor Game to check which player wins
10	Game of replacing array elements

Text Books/Reference Books	
1	Game Theory" Michael Maschler, Eilon Solan, Shmuel Zamir
2	Multiagent Systems" Y. Shoham and K. Leyton Brown, Cambridge University Press, online copy available
3	Game Theory and Mechanism Design" Y. Narahari, World Scientific and IISc Press – Indian edition available
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BHARATI VIDYAPEETH

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COLLEGE OF ENGINEERING, PUNE

B. Tech. (Computer Engineering) (2023 Course)

Minor Degree Programme III : Cyber Security

Sr. No	Category	Semester	Name of the Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Information Security	3	2	-	60	40	25	-	25	150	3	1	-	4
2.	MI	IV	Network Security	3	2	-	60	40	25	-	25	150	3	1	-	4
3.	MI	V	Basics of Ethical Hacking	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	MI	VI	Cyber Forensics and Laws	3	2	-	60	40	25	-	25	150	3	1	-	4
5.	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

INFORMATION SECURITY					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites:

Fundamentals of Computer Networks, Operating Systems.

Course Outcomes

After completion of the course students would be able to:

1	Understand security parameters and cryptosystems.
2	Demonstrate various issues related to threats like Threat Analysis, threat awareness and th modelling
3	Explain security and access control models
4	Describe aspect of information security management including planning, process, policy, procedure and monitoring
5	Identify security issues related to networks, operating systems and database
6	Define information audit and business continuity planning concepts.

Topics covered

UNIT-I	**Overview of Security Parameters and Cryptosystems** Confidentiality, Integrity and Availability, Security violation and threats, Security policy and procedure, Assumptions and Trust, Security Assurance, Implementation and Operational Issues, Security Life Cycle. Simple Cryptosystems: Enciphering Matrices, Encryption Schemes, Symmetric and Asymmetric Cryptosystems, Cryptanalysis, Different Ciphers used for Information Security, Secure Cryptosystem.	**(06 Hours)**
UNIT-II	**Security Threats**	**(06 Hours)**

	Sources of security threats: Motives - Target Assets and Vulnerabilities, Consequences of threats- E-mail threats - Web- threats - Intruders and Hackers, Insider threats, Cybercrime Security Threat Management: Risk Assessment - Forensic Analysis - Security threat correlation – Threat awareness - Vulnerability sources and assessment- Vulnerability assessment tools -Threat identification - Threat Analysis - Threat Modelling - Model for Information Security Planning.	
UNIT-III	**Access Control Models** Discretionary, mandatory, roll-based and task-based models, unified models, access control algebra, temporal and spatio-temporal models, Authorization and Authentication - types, policies and techniques, Trusted Computing and multilevel security – Security models, Trusted Systems.	**(06 Hours)**
UNIT-IV	**Security Policies** Confidentiality policies, integrity policies, hybrid policies, non- interference and policy composition, international standards, Security certification - Security monitoring and Auditing - Security Requirements Specifications - Security Policies and Procedures, Role of Information Security Department.	**(06 Hours)**
UNIT-V	**Logic-based System** Malicious logic, vulnerability analysis, auditing, intrusion detection. Applications: Network security, user security, program security. Database Security Architecture, Operating Systems Security, Enterprise Security, Data privacy, introduction to digital forensics, Incidence Response and Forensics, Enterprise security specification, Software security issues, Email and Internet use policies, Third Party Development - Intellectual Property Issues.	**(06 Hours)**
UNIT-VI	**Auditing and Business Continuity Planning** Introduction to information security audit and principles of audit. Business continuity planning and disaster recovery. Case study: 9/11 tragedy. Backup and recovery techniques for applications and storage. Audit Tools: NESSUS and NMAP. Information Security Standards and Compliance: Overview of NIST, OWASP, HIPPA, CIS, ISO 17799 Standards, Legal and Ethical issues, Database auditing.	**(06 Hours)**

Project Based Learning	
1	ISO 17799 Standard
2	NESSUS and NMAP Audit Tools
3	Asymmetric Cryptosystems
4	Build your own encryption software
Term Work: The term work shall consist of record of minimum eight experiments performed by the student:	
1	Implement the Caesar cipher algorithm.
2	1. Implement 2.1Rail Fence Cipher 2.2 Rail Fence Columnar Transposition cipher
3	Implement in c to implement Hill Cipher Algorithm.
4	Implement DES Algorithm
5	Implement AES Algorithm
6	Implement Blowfish Algorithm
7	Implement Triple DES Algorithm
8	Implement RSA Algorithm
9	Implement DSA Algorithm
10	Case study on cyber security
Text Books/Reference Books	
1	William Stallings and Lawrie Brown, “Computer Security: Principles and Practice”, Prentice Hall
2	Thomas Calabres and Tom Calabrese, “Information Security Intelligence: Cryptographic Principles & Application”, Thomson Delmar Learning
3	Nina Godbole, Information Systems Security-Security Management, Metrics, Frameworks and Best Practices, Wiley
4	Neal Koblitz, “A Course in Number Theory and Cryptography”, 2ndEdition, Springer
5	Information Security Policies, Procedures, and Standards: Guidelines for Effective Information Security Management (Paperback) Auerbach,1st edition
6	Hemant Deshmukh, “Guide to Cyber Security”, Hind Law House.

Syllabus for Unit Test:
Unit Test I : Units I, II, and III
Unit Test II : Units IV, V, and VI

NETWORK SECURITY					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites

Computer Network

Course Outcomes

After completion of the course students would be able to:

1	Explain the concept of security needed in communication of data through computers and networks along with various possible attacks.
2	Define Key Concepts in Symmetric Cryptography.
3	Identify Various Encryption mechanisms for secure transmission of data and management of key required for required for encryption.
4	Describe various Network security Protocol.
5	To develop security mechanisms to protect computer systems and networks.
6	Demonstrate authentication requirements and study various authentication mechanism.

Topics covered

UNIT-I	**Introduction to Network Security** Introduction: Definitions & Overview of network security concepts, Need for Security, Importance of network security, Security threats and vulnerabilities, Types of attacks and attackers, Services and Mechanisms, Network Security Model.	**(06 Hours)**
UNIT-II	**Symmetric Ciphers** Substitution &Transposition Techniques, Block Cipher, symmetric encryption Algorithms: AES, DES, Triple DES, Stream Ciphers, RC4.	**(06 Hours)**

UNIT-III	**Public Key Cryptography** Need and Principles of Public Key Cryptosystems, RSA Algorithm, Key Distribution and Management, Diffie-Hellman, Key Exchange, Digital Signatures.	**(06 Hours)**
UNIT-IV	**Network Security Protocols** Secure Sockets Layer (SSL) and Transport Layer Security (TLS), E-mail security-PGP, IP Security (IPSec), Virtual Private Networks (VPNs), Wireless security protocols (WPA, WPA2, WPA3), Firewall.	**(06 Hours)**
UNIT-V	**Firewalls and Intrusion Detection Systems (IDS)** Types of firewalls (stateful, stateless), Firewall configurations and rule sets, Intrusion detection and prevention systems, Network-based vs. host-based IDS.	**(06 Hours)**
UNIT-VI	**Network Access Control (NAC) and Authentication** Access control models (DAC, MAC, RBAC), Authentication Requirements, Message Authentication Codes, Hashes, MD5 & SHA, Authentication Methods: Password, Certificate based & Biometric Authentication, Kerberos.	**(06 Hours)**

Project Based Learning	
1	Design a network topology that includes various components such as routers, switches, servers, and client machines.
2	Set up rules and alerts to detect common types of attacks.
3	Configure firewall rules to allow/deny specific types of traffic based on security policies.
4	Implement a firewall to control and monitor incoming and outgoing network traffic.
5	Deploy an intrusion detection system to monitor the network for suspicious activities.
6	Configure a Virtual Private Network (VPN) for secure remote access to the organization's network.
7	Implement SSL/TLS to secure web communication within the organization.
8	Implement measures to prevent unauthorized access to the wireless network.
9	Evaluate different VPN protocols and choose the most suitable one based on security requirements.
10	Design VLANs to separate different departments or functions within the organization.

Term Work: The term work shall consist of record of minimum eight experiments performed by the student:

1	Introduction to Cryptography based Security Tools.
2	Write a Program in C/Java to implement symmetric encryption.
3	Write a Program in C/Java to implement asymmetric encryption.
4	Introduction to GnuPG encryption system.
5	Implementation of Decryption techniques using secret key in GnuPG.
6	Implementation of various cryptographic algorithms using HashCalc.
7	Study of how Firewall works in computing.
8	Study of how Antivirus works according to offline or online mode.
9	Implement mini project to develop antivirus application.
Text Books/Reference Books	
1	“Cryptography & Network Security”, PHI by William Stalling
2	“Cryptography & Network Security”, Mc Graw Hill by Atul Kahate
3	“Cryptography & Network Security”, PHI 4 by Forouzan
4	"Modern Cryptography, Theory & Practice", Pearson Education. Wenbo Mao.
5	"An Introduction to Mathematical Cryptography", Springer. Hoff stein, Pipher, Silverman.
6	"Algorithmic Cryptanalysis", CRC Press. A. Joux
7	"Number Theory", Tata Mc Graw Hill. S. G. Telang
8	"Protocols for Authentication and Key Establishment", Springer. C. Boyd, A. Mathuria.
9	"Computer Security", Pearson Education. Matt Bishop
10	“Understanding Cryptography”, Springer-Verlag Berlin Heidelberg. Christof Paar, Jan Pelzl
11	“Hemant Deshmukh, “Guide to Cyber Security”, Hind Law House.
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BHARATI VIDYAPEETH

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COLLEGE OF ENGINEERING, PUNE

B. Tech. (Computer Science & Engineering) (2023 Course)

Minor Degree Programme: Blockchain

Sr. No	Category	Semester	Name of the Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Introduction to Blockchain	3	2	-	60	40	25	-	25	150	3	1	-	4
2.	MI	IV	Decentralize & Blockchain Technologies	3	2	-	60	40	25	-	25	150	3	1	-	4
3.	MI	V	Smart Contract & Cryptocurrency	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	MI	VI	Blockchain Solutions	3	2	-	60	40	25	-	25	150	3	1	-	4
5.	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

INTRODUCTION TO BLOCKCHAIN		
Teaching Scheme	**Examination Scheme**	**Credits Allotted**
Theory : 03 Hours/Week	End Semester Examination : 60 Marks	Theory : 03
Practical : 02 Hours/Week	Internal Assessment : 40 Marks	Practical : 01
Total : 05 Hours /Week	Term-work : 25 Marks	Total Credits : 04
	Oral : 25 Marks	
	Total : 150 Marks	

Course Pre-requisites: The students should have knowledge of Computer Networks; Operating Systems; Cryptography and Network Security.

Course Outcomes

After successfully completing the course, the students will be able to:

1	Remember Fundamental Concepts Related to Blockchain Technology.
2	Understand The Principles of How Blockchain Achieves Decentralization and Immutability.
3	Apply Blockchain Concepts to Real-World Scenarios.
4	Analyze Different Consensus Mechanisms and Their Suitability for Specific Use Cases.
5	Evaluate The Ethical Considerations and Challenges Associated with BlockchainTechnology.
6	Create A Simple Blockchain Application or Prototype.

Topics covered

UNIT-I	**Introduction:** Need For Distributed Record Keeping, Modeling Faults and Adversaries, Byzantine Generals Problem, Consensus Algorithms And Their Scalability Problems, Nakamoto's Concept With Blockchain Based Cryptocurrency, Technologies Borrowed In Blockchain – Hash Pointers, Consensus, Byzantine Fault-Tolerant Distributed Computing, Digital Cash Etc.	**(06 Hours)**
UNIT-II	**Basic Distributed Computing & Crypto Primitives:** Atomic Broadcast, Consensus, Byzantine Models of Fault	**(06 Hours)**

	Tolerance, Hash Functions, Puzzle Friendly Hash, Collison Resistant Hash, Digital Signatures, Public Key Crypto, Verifiable Random Functions, Zero-Knowledge Systems	
UNIT-III	**Bitcoin Basics:** Bitcoin Blockchain, Challenges and Solutions, Proof of Work, Proof Of Stake, Alternatives To Bitcoin Consensus, Bitcoin Scripting Language And their use cases.	**(06 Hours)**
UNIT - IV	**Ethereum Basics:** Ethereum And Smart Contracts, The Turing Completeness of Smart Contract Languages And Verification Challenges, Using Smart Contracts To Enforce Legal Contracts, Comparing Bitcoin Scripting Vs. Ethereum Smart Contracts, Writing Smart Contracts Using Solidity & Javascript.	**(06 Hours)**
UNIT - V	**Privacy, Security Issues In Blockchain:** Pseudo-Anonymity Vs. Anonymity, Zcash And Zk-SNARKS For Anonymity Preservation, Attacks On Blockchains: Sybil Attacks, Selfish Mining, 51% Attacks Advent Of Algorand; Sharding Based Consensus Algorithms To Prevent These Attacks	**(06 Hours)**
UNIT-VI	**Case Studies:** Block Chain in Financial Service, Supply Chain Management and Government Services	**(06 Hours)**
Project Based Learning: ANYONE based on following topics but not limited to-		
1	Trusted Crowdfunding Platform Using a Smart Contract.	
2	Exact Shipment Location Data.	
3	Peer To Peer Ridesharing.	
4	A Fake Product Identification System.	
5	Transparent And Genuine Charity Application.	
6	Blockchain-Based Voting System.	
7	Anti-Money Laundering System Using Blockchain.	
Term Work: The term work shall consist of a record of minimum eight experiments performed by the student:		

1	Installation Of Metamask and Study Spending Ether Per Transaction.
2	Create Your Own Wallet Using Metamask for Crypto Transactions.
3	Write A Smart Contract on A Test Network, For Bank Account Of A Customer For FollowingOperations: • Deposit Money • Withdraw Money • Show Balance
4	Write A Program in Solidity to Create Student Data. Use The Following Constructs: • Structures • Arrays • Fallback
5	Deploy This as Smart Contract on Ethereum And Observe The Transaction Fee And GasValues.
6	Write A Survey Report on Types of Blockchains and Its Real Time Use Cases.
7	Write A Program to Create a Business Network Using Hyperledger.
8	To understand the application of blockchain technology in supply chain management and develop a simple blockchain-based supply chain network.
9	**Mini Project -** Develop A Blockchain Based Application Dapp (De-Centralized App) For E-Voting System.
Text Books/ Reference Books	
1	Artemis Caro, "Blockchain: The Beginners Guide to Understanding the Technology Behind Bitcoin & Crypto Currency".
2	Ambadas, Arshad Sarfarz Ariff, Sham "Blockchain for Enterprise Application Developers", Wiley
3	Andreas M. Antonpoulos, "Mastering Bitcoin: Programming The Open Blockchain", O'Reilly.
4	Blockchain: A Practical Guide To Developing Business, Law, And Technology Solutions, Joseph Bambara, Paul R. Allen, Mc Graw Hill.
5	Blockchain: Blueprint For A New Economy, Melanie Swan, O'Reilly.
6	Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, And Smart Contracts Explained", Packt Publishing.

7	Josh Thompson, 'Blockchain: The Blockchain For Beginnings, Guild To Blockchain Technology And Blockchain Programming', Create Space Independent Publishing Platform, 2017.
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

DECENTRALIZE & BLOCKCHAIN TECHNOLOGIES					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theor	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		
Course Pre-requisites: The students should have knowledge of Basics of Blockchain Technology					
Course Outcomes					
After successfully completing the course, the students will be able to:					
1	Analyze The Strengths and Weaknesses of Different Decentralized Systems				
2	Evaluate The Potential Impact of Decentralized Applications on Specific Industries or Societal Issues.				
3	Analyze The Trade-Offs and Suitability of Different Consensus Algorithms for VariousScenarios.				
4	Compare And Contrast Hyperledger Fabric with Other Platforms Based on Specific Criteria.				
5	Develop And Evaluate Mitigation Strategies for Specific Blockchain Security Threats.				
6	Design And Defend a Proposal for Utilizing Blockchain Technology in A ChosenApplication Area.				
Topics covered					
UNIT-I	**Decentralized Systems:** Introduction To Decentralization, Core Principles of			**(06 Hours)**	

	Decentralization, Types of Decentralized Systems, Disintermediation And Its Impact, Frameworks And Ecosystems Or Decentralized System.	
UNIT-II	**Decentralized Applications:** Introduction to Decentralized Applications, Dapp Development Environment and Tools, Dapp Use Cases, Blockchain Mining and Dapps, Communication Protocols (Whisper, Swarm), Blockchain Forks and Implications for Dapps.	**(06 Hours)**
UNIT-III	**Securing Blockchains: Consensus And Fault Tolerance:** Introduction To Consensus, Consensus Approaches And Elements, Consensus Algorithms: Proof Of Work, Byzantine General Problem, Proof Of Stake, Proof Of Elapsed Time, Proof Of Activity, Proof Of Burn. Comparing And Contrasting Consensus Algorithms.	**(06 Hours)**
UNIT - IV	**Hyperledgers:** Introduction To Permissioned Blockchains, Hyperledger Ecosystem Overview, Deep Dive into Hyperledger Projects, Hyperledger Tools and Libraries, Building With Hyperledger, Blockchain-As-A-Service (Baas) And Hyperledger Cello, Future Of Hyperledger And Permissioned Blockchains.	**(06 Hours)**
UNIT - V	**Advanced Blockchain Security: Attacks, Solutions, And Best Practices** Blockchain Security Fundamentals, Pseudonymity Vs. Anonymity, Privacy-Enhancing Technologies, Common Dvent of Algorand, and Sharding Based Consensus Algorithms to Prevent The Attacks	**(06 Hours)**
UNIT-VI	**Blockchain For The Real World:** Selecting Blockchain Technology, Business Need Identification a nd Goal Setting, Blockchain Applications Across Industries: Internet Of Things (IOT), Medical Record Management: Domain Name Service (DNS), Future Of	**(06 Hours)**

	Blockchain Technology.	
Project Based Learning: ANYONE based on following topics but not limited to-		
1	Cryptocurrency Wallet Simulator	
2	Nft Minting And Marketplace	
3	Supply Chain Transparency Game	
4	Personal Carbon Footprint Tracker	
5	Decentralized Voting System Simulator	
6	Peer-To-Peer Energy Trading Platform	
7	Decentralized Identity Management System	
8	Healthcare Data Sharing Platform	
9	Decentralized Autonomous Organization (Dao) For Charity Fundraising	
10	Decentralized Social Media Platform	
11	Interoperable Blockchain Bridge	
Term Work:. The term work shall consist of a record of minimum eight experiments performed by the student:		
1	Decentralized Application Analysis.	
2	Develop A Simple Web Application That Allows Users to Track Their Carbon Footprint through Connected Devices or Manual Input.	
3	Design A Secure and Transparent Voting System Using Blockchain for Student Elections or Decision-Making Within Clubs or Organizations.	
4	Develop A Prototype Platform for Patients to Securely Store and Share Their Medical Records Using Blockchain Technology.	
5	Decentralized Supply Chain Management for Local Produce.	
6	Design A Peer-To-Peer Energy Trading Platform Using Blockchain Technology.	
7	Design A Platform for Decentralized Educational Credentials & Skill Verification.	
8	Develop a simple application that allows businesses to issue and track loyalty points for customers using a blockchain, ensuring transparency and security in	

	reward distribution.
Text Books/ Reference Books	
1	J.H. Huiwitz, M.Kaufman, A.Bowles, " Cognitive Computing & Big Data Analystics",Wiley Publication
2	A. Reyana, C.Martin, J.Chen, E.Soler, M.Diaz, "On Blockchain And Its Integration With Iot Challenges & Opportunities" Paper In Future Generation Computer Systems, Vol. 88, Nov. 2018, Pp.173-190.
3	H.F.Atlam, Muhammad A.A.,A.G. Alzaharani, G. Wills, "A Review Of Blockchain In Internet Of Things And AI",Paper In Big Data And Cognitive Computing, Vol.4, Issue 28, Oct.2020.
Syllabus for Unit Test:	
Unit Test I	: Units I, II, and III
Unit Test II	: Units IV, V, and VI

BHARATI VIDYAPEETH

(DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (Computer Science & Business Systems) (2023 Course)

Minor Degree Programme: Business Systems

Sr. No	Category	Semester	Name of Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Business Strategy	3	2	-	60	40	25	25	-	150	3	1	-	**4**
2.	MI	IV	Introduction to Innovative IP Management & Entrepreneurship	3	2	-	60	40	25	25	-	150	3	1	-	**4**
3.	MI	V	Marketing Research and Marketing Management	3	2	-	60	40	25	25	-	150	3	1	-	**4**
4.	MI	VI	Financial and Cost Accounting	3	2	-	60	40	25	25	-	150	3	1	-	**4**
5.	MI	VI	Project	-	8	-	-	-	50	50	-	100	-	4	-	**4**
			Total	**12**	**16**	**-**	**240**	**160**	**150**	**150**	**-**	**700**	**12**	**8**	**-**	**20**

BUSINESS STRATEGY					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		
Course Pre-requisites: The students should have an introductory awareness of business terminologies and functions.					
Course Outcomes					
After completion of the course students would be able to:					
1	To summarize the important concepts of strategic management.				
2	To identify the process and capabilities for the internal environment of a firm.				
3	To understand the strategies applicable for external environments of firm.				
4	To examine corporate strategies.				
5	To compare the various business growth strategies.				
6	To understand the process of strategy implementation.				
Topics covered					
UNIT-I	**Introduction to Strategic Management:** Importance of Strategic Management, Vision and Objectives, Schools of thought in Strategic Management, Strategy Content, Process, and Practice, Fit Concept and Configuration Perspective in Strategic Management.			**(06 Hours)**	
UNIT-II	**Internal Environment of Firm- Recognizing a Firm's Intellectual Assets:** Core Competence as the Root of Competitive Advantage, Sources of Sustained Competitive Advantage, Business Processes and Capabilities-based Approach to Strategy.			**(06 Hours)**	
UNIT-III	**External Environments of Firm- Competitive Strategy:**			**(06 Hours)**	

	Five Forces of Industry Attractiveness that Shape Strategy, The concept of Strategic Groups, and Industry Life Cycle, Generic Strategies, Generic Strategies and the Value Chain.	
UNIT-IV	**Corporate Strategy:** The Motive for Diversification, Related and Unrelated Diversification, Business Portfolio Analysis.	**(06 Hours)**
UNIT-V	**Growth Strategies:** Expansion, Integration and Diversification, Strategic Alliances, Joint Ventures, and Mergers & Acquisitions.	**(06 Hours)**
UNIT-VI	**Strategy Implementation: Structure and Systems:** The 7S Framework, Strategic Control and Corporate Governance.	**(06 Hours)**

Project Based Learning: ANYONE based on following topics but not limited to-	
1	Choose an organization and do analysis of Vision Mission and Objectives.
2	Case study of an organization through the lens of ten school of thoughts.
3	Select an organization and do analysis of it from the perspective of fit concepts and configuration.
4	Study a research paper related to core competencies and build your opinion related to taking advantage of core competencies.
5	Analyze the process of Business Processes and Capabilities-based Approach to Strategy.
6	Case study on Porter's Five forces.
7	Do generic study of different strategies and prepare a research paper on them.
8	Do a case study on motives of diversifications.
9	Choose an organization and prepare a business portfolio.
10	Make an analysis of different expansion strategies and prepare a research paper on it.
Term Work: The term-work shall consist of Minimum **Eight Assignments** from list below.	
1	Define strategic management and its significance in organizations.
2	Provide examples of companies that have successfully implemented a capabilities-based approach to strategy.
3	Provide real-world examples of companies with strong core competencies.
4	Analyze the implications of belonging to a particular strategic group for a firm's competitive position.

5	Discuss the different stages of the industry life cycle (introduction, growth, maturity, and decline).
6	Explain Porter's three generic strategies (cost leadership, differentiation, and focus).
7	Analyze factors that influence a firm's choice of generic strategy.
8	Analyze the potential drawbacks of diversification, including increased complexity and potential for resource misallocation.
9	Discuss different types of strategic alliances, such as joint ventures, licensing agreements, and equity alliances.
10	Discuss the seven interrelated elements of the 7S Framework (Strategy, Structure, Systems, Style, Staff, Skills, and Shared Values).
Text Books/Reference Books	
1	Robert M. Grant (2012). Contemporary Strategic Management, Blackwell, 7th Edition.
2	M.E. Porter, Competitive Strategy, 1980. M.E. Porter.
3	Competitive Advantage, 1985 Richard Rumelt (2011).
4	Good Strategy Bad Strategy: The Difference and Why It Matters.
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: The students should have a good knowledge of the fundamentals of management.

Course Outcomes

After completion of the course students would be able to:

1	Learn to be familiar with creative and innovative thinking styles.
2	Learn opportunity reorganization and entrepreneurship skills.
3	Learn to investigate, understand and internalize the process of finding a startup.
4	Understand financial aspects of Entrepreneurship.
5	Learn to manage various types of IPR to protect competitive advantage.
6	Understand the types of IP.

Topics covered

UNIT-I	**Innovation: What and Why?** Innovation as a core business process, Sources of innovation, Knowledge push vs. need pull innovations. Class Discussion- Is innovation manageable or just a random gambling activity?	**(06 Hours)**
UNIT-II	**Building an Innovative Organization:** Creating new products and services, exploiting open innovation and collaboration, use of innovation for starting a new venture. Class Discussion- Innovation: Co-operating across networks vs. go-it-alone' approach.	**(06 Hours)**

UNIT-III	**Entrepreneurship:** Opportunity recognition and entry strategies, Entrepreneurship as a Style of Management, Maintaining Competitive Advantage- Use of IPR to protect Innovation.	**(06 Hours)**
UNIT-IV	**Entrepreneurship - Financial Planning:** Financial Projections and Valuation. Stages of financing, Debt, Venture Capital, and other forms of Financing.	**(06 Hours)**
UNIT-V	**Intellectual Property Rights (IPR):** Introduction and the economics behind development of IPR: Business Perspective, IPR in India – Genesis and Development, International Context, Concept of IP Management, Use in marketing.	**(06 Hours)**
UNIT-VI	**Types of Intellectual Property:** Patent- Procedure, Licensing and Assignment, Infringement and Penalty, Trademark- Use in marketing, example of trademarks- Domain name, Geographical Indications- What is GI, Why protect them? Copyright- What is copyright, Industrial Designs- What is design? How to protect? Class Discussion- Major Court battles regarding violation of patents between corporate companies.	**(06 Hours)**

Project Based Learning: ANYONE based on following topics but not limited to-	
1	Case study on: Artificial Intelligence.
2	Case study on: Machine Learning.
3	Case study on: Cloud Computing.
4	Case study on: IOT.
5	Case study on: HCI.
6	Case study on: Brain Computer Interface.
7	Case study on: Web Designing.
8	Case study on: Blockchain.

Term Work: The term work shall consist of a record of minimum eight experiments performed by the student:	
1	Analyze strategies and sources of innovation of well-known companies that has successfully implemented innovative practices.

2	Research and analyze the development of the iPhone (knowledge push) and the Post-it notes (need pull). Compare and contrast the strategies, outcomes, and implications of these two approaches to innovation.
3	Develop a comprehensive innovation strategy for a hypothetical startup in the renewable energy sector, considering factors such as the company's mission, vision, and available resources.
4	Analyze Tesla's open innovation strategy, discussing the benefits, challenges, and best practices associated with their approach to collaboration and innovation.
5	Develop a comprehensive business plan for a new venture that offers personalized nutrition plans based on genetic testing, considering market analysis, financial projections, and the competitive landscape.
6	Analyze the various stages of financing for entrepreneurial ventures, including seed stage, early-stage, and growth stage funding, and discuss the types of funding available at each stage and the key factors to consider when seeking investment.
7	Compare and contrast debt financing, venture capital, and other forms of financing for entrepreneurial ventures, discussing their advantages, disadvantages, and suitability for different types of businesses.
8	Research and analyze the patent application process in India, outlining the steps involved, requirements for patentability, examination process, and grant of a patent, using a pharmaceutical invention as an example.
9	Analyze recent cases of patent infringement in India and discuss the applicable laws, remedies available to patent owners, and penalties imposed on infringers.
Text Books/Reference Books	
1	Joe Tidd, John Bessant. Managing Innovation: Integrating Technological, Market and Organizational Change.
2	Case Study Materials: To be distributed for class discussion.
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BHARATI VIDYAPEETH

(DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (Information Technology) (CBCS-2023 Course)

Minor Degree Program: Cloud Technologies

Sr. No	Category	Semester	Name of the Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Distributed Computing	3	2	-	60	40	25	-	25	150	3	1	-	4
2.	MI	IV	Cloud Systems and Infrastructures	3	2	-	60	40	25		25	150	3	1	-	4
3.	MI	V	Cloud Virtualization	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	MI	VI	Cloud Containers and Orchestrations	3	2	-	60	40	25	-	25	150	3	1	-	4
5.	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

DISTRIBUTED COMPUTING					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: Data Structures, Operating Systems, Networking concepts

Course Outcomes

After completion of the course students would be able to:

1	Discover the fundamentals of distributed computing environment
2	Observe the inter process communication
3	Infer the concepts of process and threads
4	Interpret the concepts of clock synchronization
5	Infer the concepts of Distributed file system
6	Interpret the concepts distributed shared memory

Topics covered

UNIT-I	**Fundamentals** Definition and evolution of Distributed Computing System, Models and Types of Distributed Computing Systems, Issues and Goals in designing Distributed System, Distributed Computing Environment, Peer to peer systems and its middleware, Routing overlays, Mobile and Ubiquitous computing, Data Center architecture and management.	**(06 Hours)**
UNIT-II	**Communication**. Interprocess communication (IPC): Introduction and need Message Passing system: Desirable features of good message passing system, Issues in IPC, Group and multicast communication, Remote Procedure Calls (RPC): The RPC Model, Implementation of RPC mechanisms (Stubs and marshalling) Java	**(06 Hours)**

	RMI: Architecture, Implementation (Stubs and Skeletons), Introduction of Web services and SOAP.	
UNIT-III	**Processes and Threads** Process Migration: Introduction, Features, Mechanisms, Advantages, use in heterogeneous systems. Threads: Concept, Motivation, Models, Issues, Synchronization, Scheduling, Implementing.	**(06 Hours)**
UNIT-IV	**Synchronization and Distributed Transactions** Clock synchronization: Drifting, Issues, Algorithms, Event Ordering Deadlock: Conditions, Modeling, Handling, Avoidance, Prevention, Detection, Election Algorithms. Distributed Transaction: Introduction, Locks, Optimistic Concurrency Control, Timestamp Ordering.	**(06 Hours)**
UNIT-V	**Distributed File system** Distributed Files Systems: Advantages, Features, Models, Caching, Replication, Fault Tolerance.	**(06 Hours)**
UNIT-VI	**Distributed Shared memory** Distributed Shared Memory: Architecture, Design and Implementation Issues, Advantages, Granularity, Structure of Shared Space, Consistency Models, Replacement Strategy, Thrashing.	**(06 Hours)**

Project Based Learning: The students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.

Term Work: The term work shall consist of a record of minimum eight experiments performed by the student. The course coordinator shall design suitable laboratory exercises on Opensource distributed systems, inter-process communications, threads, election algorithms etc.

Text Books/Reference Books

1	Mastering Cloud Computing, Buyya R, Vecchiola C, Selvi S T, McGraw Hill Education (India), 2013.
2	Cloud Computing Bible, Barrie Sosinsky ,Wiley Publishing Inc. 2011
3	Cloud Computing from Beginning to End by Ray J Rafaels

4	Ajay D. Kshemkalyani, Mukesh Singhal, “Distributed Computing: Principles, Algorithms, and Systems”, Cambridge University Press- South Asian edition.
5	Abraham Silberschatz, Peter B. Galvin, Greg Gagne , “Operating System Concepts”, Wiley, 8th Edition.
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

CLOUD SYSTEMS & INFRASTRUCTURES					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: Operating System, Computer Networks.

Course Outcomes

After completion of the course students would be able to:

1	Understand the main concepts, key technologies and fundamentals of cloud computing.
2	Analyse various cloud computing models and apply them to solve problems on cloud.
3	To discuss system virtualization and outline its role in enabling the cloud computing system model.
4	Understand cloud infrastructure and storage.
5	Analyse the core issues of cloud computing such as security, privacy, and interoperability.
6	Understand the trends in cloud enabling technologies.

Topics covered

UNIT-I	**Introduction to Cloud Technologies** Introduction to the Cloud Computing, History of cloud computing, Cloud service options, Cloud Deployment models, Business concerns in the cloud.	**(06 Hours)**
UNIT-II	**Cloud computing Architecture** Introduction, delivery models: The SPI framework, Meaning of cloud service model, Types of cloud service models, characteristics and benefits, Difference between all models, cloud deployment models,Cloud Reference Model, Types of Clouds, Economics of Clouds, Open Challenges, Cloud Platforms in Industry: Amazon Web Services, Google App Engine, And Microsoft Azure	**(06 Hours)**
UNIT-III	**Virtualization and cloud platform**	**(06 Hours)**

	Exploring virtualization, Load balancing, Hypervisors, Machine imaging, Cloud marketplace overview, Comparison of Cloud providers .	
UNIT-IV	**Cloud Infrastructure and storage** History of data centers and their components like IT equipment and facilities along with design considerations like efficiency power, requirements, redundancy etc. Cloud storage systems, their concepts and object storage, databases, distributed file systems.	**(06 Hours)**
UNIT-V	**Cloud Security** Securing the Cloud, The security boundary, Security service boundary, Security mapping, Securing Data, Brokered cloud storage access, Storage location and tenancy, Encryption, Auditing and compliance, Establishing Identity and Presence, Identity protocol standards.	**(06 Hours)**
UNIT-VI	**Advanced Topics in Cloud Computing** Energy Efficiency in Clouds, Market Based Management of Clouds, Federated Clouds / InterCloud, Third Party Cloud Services. Cloud Service Providers: EMC, EMC IT, Captiva Cloud Toolkit, Google, Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services,Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue , Windows Azure, Microsoft Assessment and Planning Toolkit..	**(06 Hours)**
Project Based Learning:		
1	To transfer the files from one virtual machine to another virtual machine.	
2	Installing and running GATE.	
3	To Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.	
4	To Implement IaaS using your resources.	
5	Design and deploy a PaaS environment.	
6	Installation and Configuration of virtualization using KVM.	
7	Study Cloud Security management.	
8	Case study on Amazon EC2/Microsoft Azure/Google Cloud Platform.	

9	Study and implementation of Storage as a Service.
10	Study and implementation of identity management.
Term Work: The term work shall consist of a record of minimum eight experiments performed by the student. The course coordinator shall design suitable laboratory exercises on Opensource distributed systems, inter-process communications, threads, election algorithms etc.	
Textbooks/Reference Books	
1	Mastering Cloud Computing, Buyya R, Vecchiola C, Selvi S T, McGraw Hill Education (India), 2013.
2	Cloud Computing Bible, Barrie Sosinsky, Wiley Publishing Inc. 2011.
3	Cloud Computing from Beginning to End by Ray J Rafaels.
4	Cloud Computing - Principles and Paradigm, Buyya R, Broberg J, Goscinski A, Wiley, 2011.
5	Cloud Computing: Concepts, Technology & Architecture by Zaigham Mahmood, Ricardo Puttini, Thomas Erl,2013.
6	The Basics of Cloud Computing: Understanding the Fundamentals of Cloud Computing in Theory and Practice by Derrick Rountree and Ileana Castrillo, 2013.
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BHARATI VIDYAPEETH

(DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (Electrical and Computer) (2023 COURSE)

Minor Degree Programme: Electric Vehicle

Sr. No	Category	Semester	Name of the Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Fundamentals of Electric & Hybrid Vehicles	3	2	-	60	40	25	-	25	150	3	1	-	4
2.	MI	IV	EV batteries & Charging system	3	2	-	60	40	25		25	150	3	1	-	4
3.	MI	V	Electric Drives and Controls for Electric Vehicles	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	MI	VI	Testing and Certification of Electric Hybrid Vehicles	3	2	-	60	40	25	-	25	150	3	1	-	4
5.	MI	VII	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

FUNDAMENTALS OF ELECTRIC & HYBRID VEHICLES					
Teaching Scheme:		**Examination Scheme:**		**Credits Allotted:**	
Theory	: 03 Hours / Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours / Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	**:** 25 marks	Total Credits	: 04
		Oral	: 25 marks		
		Total	**:** 150 Marks		

Course Pre-requisites:

The Students should have prior knowledge of Electrical Engineering

Course Outcomes:

After learning this course students would be able to

1	Identify Electric Vehicle (EVs)-issues, trends, systems.
2	Classify Electric Vehicle(EVs)
3	Clarify Electric Vehicle Architecture
4	Clarify Hybrid Vehicle Architecture
5	Describe Power train components of Electric and Hybrid Vehicles
6	Apply energy management strategies to Electric Vehicle systems

Topics covered

UNIT – I	**Electric Vehicle (EV) -issues, trends, systems** Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV Concept, Key EV Technology, State-of-the Art EVs & HEVs, Comparison of EV Vs IC Engine. EV System: EV Configuration: Fixed & variable gearing, single & multiple motor drive, In-wheel drives EV Parameters: Weight, size, force, and Energy & performance parameters.	**(06 Hours)**
UNIT - II	**Classification of Electric Vehicles(EVs)** Classification of EVs in reference of Propulsion devices, Energy sources, Energy carriers, Pure Electric Vehicles (PEV), Hybrid Electric Vehicles (HEV) and Plug-in Hybrid Electric Vehicles (PHEV), Configurations: Battery Electric Vehicles (BEV), Fuel cell electric vehicles (FCEVs), Conventional full HEV.	**(06 Hours)**

UNIT - III	**Hybrid Vehicle Architecture** Introduction , Concept of Hybrid Electric Drive trains , Architectures of Hybrid Electric Drive trains , Series and Parallel Hybrid Electric Drive trains ,Coupling Modes , Operating Modes, Hybridization factor , Plug-in hybrid electric vehicles (PHEVs) , Performance characteristics	**(06 Hours)**
UNIT -IV	**Electric Vehicle Architecture** Introduction, Configurations , Traction Motor Characteristics , Tractive Effort and Transmission Requirement , Power Flow Control in Electric Drive train , Positioning of Motors ,Vehicle Performance , Tractive Effort in Normal Driving , Energy Consumption , Single and Multi Motor drives	**(06 Hours)**
UNIT -V	**Power train components of Hybrid and Electric Vehicles** Traction Motor Types , Configuration and Control , DC Motor, Brushless DC Motor , BLDC Motor Control , Switched Reluctance Motor, AC Induction, Motor Drives and Introduction to Power electronic components, Electronic Control Unit of Motors , Various Control Modes , Drive system Efficiency	**(06 Hours)**
UNIT - VI	**Power train Energy Management System** : Introduction to energy management strategies , classification of energy management strategies , rule based and optimization strategies , real-time working of energy management system in HEV , model-based design and simulation process , Implementation issues of energy management strategies	**(06 Hours)**

Project Based Learning: The **s**tudents are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.

Term Work: The term work shall consist of record of minimum eight experiments performed by the student:

1	Study of BLDC / PMSM/AC Induction electric vehicle motor
2	Study of various batteries used for Electric Vehicle(Industry visit to manufacturing company)
3	Study of basic controllers for Electric Vehicle
4	Study of electric vehicle lighting system
5	Study of electric vehicle charger (Demonstration at EV company/MSEB charging point)
6	Modeling & simulation of electric vehicle/hybrid electric vehicle with professional software
7	Study of performance of electric vehicle using professional software
8	Demonstration of electric vehicle manufacturing (Industry visit to manufacturing company)

Text Books/Reference Books:	
1	Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2	Hybrid Electric Vehicles – Teresa Donateo, Published by ExLi4EvA, 2017
3	Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.
4	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, MehrdadEhsaniYiminGao Stefano Longo Kambiz M. Ebrahimi, Taylor & Francis Group, LLC, 2018.
5	Hybrid, Electric & Fuel-Cell Vehicles Jack Erjavec, Delmar, Cengage Learning.
6	Electric and Hybrid Vehicles, Tom Denton, Taylor & Francis, 2018.
7	Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010.
8	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2009.
9	James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
Syllabus for Unit Test:	
Unit Test I	: Unit–I, Unit–II and Unit -III
Unit Test II	: Unit –IV, Unit –V and Unit -VI

EV BATTERIES & CHARGING SYSTEM					
Teaching Scheme:		**Examination Scheme:**		**Credits Allotted:**	
Theory	: 03 Hours / Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours / Week	Continuous Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total credits	: 04
		Oral	: 25 marks		
		Total	: 150 Marks		

Course Pre-requisites:

The Students should have knowledge of

1.	Fundamentals of Electrical & Electronics Engineering

Course Outcomes:

After learning this course the students would be able to

1	Elaborate basics of batteries.
2	Understand Battery charging, Battery testing & service
3	Distinguish between various types of batteries used for EV applications.
4	To understand Charging system design technology for EV applications:
5	Understand the different infrastructure of charging stations.
6	Understand the different EV Charging Facility Planning.

Topics covered

UNIT - I	**Batteries** Introduction, Types of cells, Connecting cells, Automatic battery cells, Chemical action in the battery, Battery efficiency, Battery safety, Battery life and maintenance, ratings – parameters ,sizing	**(06 Hours)**
UNIT - II	**Battery charging**, **Battery testing & service** Battery charging: Ways of Battery charging, Overcharging and its effects, Checking battery state of charge, Battery care, Battery testing & service: Purpose of battery testing, Review of general safety, Hydrometers, Load test, Battery care, repairing cable end, Charging, Jump starting.	**(06 Hours)**

UNIT - III	**EV Batteries and Battery Management System:** EV batteries, Lead Acid batteries – Basics, Characteristics, Lithium batteries- Basics, Characteristics, Selection of battery for EVs, Smart battery pack design, Cell balancing in Li Ion, BMS - Global price trends, volumetric and gravimetric efficiency trends. Latest development in batteries and their types.	**(06 Hours)**
UNIT - IV	**Charging system design technology for EV applications:** Charging system design considerations, AC & DC Charging, Charging methods, On-board/Off- board chargers, Vehicle to charger communication system, understand the computing needs in a charging system, Understand internal major block diagrams and subsystems of low and high power chargers.	**(06 Hours)**
UNIT - V	**Charging Infrastructure** Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and- charge zone	**(06 Hours)**
UNIT - VI	**EV Charging Facility Planning:** Identification of EV demand, Impact of EV charging on power grid, Energy generation scheduling, different power sources, centralized charging schemes, Energy storage integration into micro-grid, Overview and applicability of AI for the EV ecosystem, design of V2G aggregator, case studies.	**(06 Hours)**

Project Based Learning: The **s**tudents are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.

Term Work: The term work shall consist of record of minimum eight experiments performed by the student:

1	Study of different types of batteries with their characteristics & detailed specifications with terminologies.
2	Develop a simulation model for Lead-acid and Li-ion Batteries.
3	SOC Estimation for Lead-Acid battery
4	Design a circuit for Battery monitoring System for Lead acid battery.
5	Study of Battery Management System and Monitoring.
6	Study of Battery pack, sizing & calculation of the parameters to develop a charging infrastructure.
7	Study of various types of chargers
8	Study of latest development in batteries & their types

Text Books/Reference Books:	
1	C.C.Chan, K.T.Chau. Modern Electric Vehicle Technology, Oxford University Press, NY 2001
2	M.Ehsani, Y.Gao, S.E.Gay, A.Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design, CRC Press, 2004
3	James Larminie, John Lowry. Electric Vehicle Technology Explained. Wiley 2012
4	NPTEL Course on Electric Vehicles – Part 1 by Dr. Amit Jain, IIT Delhi
5	Tests on Lithium-ion batteries. Available at: https://www.lithium-batterie-service.de/en/un-38.3-testseries
6	Handbook on Battery Energy Storage Systems- ADB, 2018
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BHARATI VIDYAPEETH

(DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (Electronics and Communication) (2023 Course)

Minor Degree Programme : Internet of Things

Sr. No	Category	Semester	Name of the Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Sensors and Actuators	3	2	-	60	40	25	-	25	150	3	1	-	4
2.	MI	IV	Communication Protocols	3	2	-	60	40	25		25	150	3	1	-	4
3.	MI	V	IoT System Design	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	MI	VI	Industrial Internet of Things	3	2	-	60	40	25	-	25	150	3	1	-	4
5.	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

SENSORS AND ACTUATORS					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites:

The Students should have knowledge of

1.Electronic Component and Devices.

2.Engineering Physics.

Course Outcomes

After completion of the course students would be able to:

1	Differentiate between sensors & transducers used in various applications.
2	Illustrate the working principles of optical sensors.
3	Identify suitable sensors for real time applications.
4	Interpret & demonstrate the role of smart sensors in IoT.
5	Learn the applications of motion & electrical sensors
6	Understand the phenomena that define the behavior of different actuators

Topics covered

UNIT-I	**Sensors & transducers** Types of sensors-Definition, parameters of sensors like sensitivity, stability, accuracy, hysteresis, drift, range, resolution, reliability, Classification of sensors, Calibration of sensors. Definition of transducer, difference between sensor & transducer, applications of transducer	**(06 Hours)**
UNIT-II	**Optical sensors** Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, photoconductive detectors, Photo	**(06 Hours)**

	diodes, Photo resistors, photo transistors, Infrared, Camera, proximity sensors,Ultrasonic sensors.	
UNIT-III	**Temperature and Acoustic sensors** Temperature sensors- thermosensitive, thermoelectric, semiconductor and optical. Piezoelectric temperature sensor. Acoustic sensors- microphones-resistive, capacitive, piezoelectric, solid state electret microphones, hydrophone.	**(06 Hours)**
UNIT-IV	**Smart sensors** Introduction to smart sensors, working principle, block diagram, roleof smart sensors in IoT, types of smart sensors viz level sensors, temperature sensors, touch sensor, proximity, gas sensor, motion sensor, water level sensors, advantages, disadvantages & applications.	**(06 Hours)**
UNIT-V	**Motion & electrical sensors** Motion sensor, noise sensor, Chemical sensor, Electrical current sensors-magnetometer, voltage detector, Navigation, instruments- gyroscope, encoder, tachometer, felx sensor. Automative sensors-airflow meter, speedometer,air-fuel ratio meter	**(06 Hours)**
UNIT-VI	**Actuators** Actuation Systems, Pneumatic and Hydraulic, Rotary actuators, Thermal actuators, Mechanical Actuation Systems, Electrical Actuation Systems, Magnetic actuators	**(06 Hours)**

Project Based Learning: The students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.

Term Work: The term work shall consist of record of minimum eight experiments performed by the student:

1	To study the characteristics of photodiodes, photodetectors, photo transistors
2	To study the characteristics of various temperature sensors vz. RTD, Thermistor
3	To study the operation of pressure sensor, water level sensor,ultrasonic
4	To study the operation of digital sensors like temperature & humidity sensor DHT 11, DHT 22
5	To study the operation of accelerometer, sound sensor
6	To study the operation of ultrasonic sensor, gas sensor, flame sensor
7	To study the operation of tracker sensor, motion sensor, touch sensor.
8	To study the operation OD relay, DC motor, servo motor

Text Books/Reference Books	
1	D. Patranabis-Sensors and Transducers, PHI Learning Private Limited.
2	W. Bolton-Mechatronics, Pearson Education Limited.
3	Patranabis-Sensors and Actuators- 2 nd Ed., PHI, 2013.
4	Robert H. Bishop-The Mechatronics Handbook, 2nd Ed., Mechatronic Systems, Sensors and Actuators, fundamentals and modelling
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

COMMUNICATION PROTOCOLS					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites:

1.To understand the layering architecture of OSI reference model and TCP/IP protocol suite and protocol associated with each layer.

2.To Interpret the various routing techniques and to formulate the security issues in the network and various security algorithms

Course Outcomes

After completion of the course students would be able to:

1	Describe the layering architecture of computer networks and distinguish betweenthe OSI reference model and TCP/IP protocol suite.
2	Identify the protocols and services of Data link layer.
3	Simulate a network model and determine the routing of packets using differentrouting algorithms.
4	Articulate the protocols and functions associated with the transport layer services.
5	Exemplify the protocols and services of the application layer
6	Simulate the wireless network using IEEE 802.11

Topics covered

UNIT-I	**Data Communications and Network Model** Introduction to Data Communications, Network Types: LAN, WAN, Switching, Internet. Network Models: OSI Model and TCP/IP Model Protocol Suite: Layered Architecture, Layers in model, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, OSI Versus TCP/IP	**(06 Hours)**

UNIT-II	**Data-Link Layer** Design issues, error detection and correction, sliding window protocols, HDLC, medium access sublayer: Channel allocations problem, multiple access protocols- Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Controlled Access Wired LANs: Ethernet: Ethernet Protocol: IEEE802,various Ethernet Standard	**(06 Hours)**
UNIT-III	**Network Layer** Network Layer services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses,IPV4 Datagram format , IPV6 Addresses, and IPV6 Datagram format, forwarding techniques, ICMPv4, routing algorithms: Distance Vector Routing, Link State Routing	**(06 Hours)**
UNIT-IV	**Transport Layer** Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols :TCP and UDP, Transport Layer sliding window protocols, Transmission Control Protocol: TCP Services, TCP Features, TCP congestion control.	**(06 Hours)**
UNIT-V	**Application layer and Security** Domain name system, electronic mail, World Wide Web: architectural overview, dynamic web document and http. Application layer protocols: Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Telnet, network security	**(06 Hours)**
UNIT-VI	**Wireless LANs** Introduction: Architectural Comparison, Characteristics, IEEE 802.11: Architecture, Bluetooth: Architecture, Layers. Connecting Devices: Hubs, Switches, Virtual LANs, Communication between Switches and Routers, Advantages.	**(06 Hours)**
Project Based Learning: The students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.		
Term Work: The term work shall consist of record of minimum eight experiments performed by the student:		

1	LANs and its components, Practically implement the cross-wired cable and straightthrough cable using clamping tool.
2	Study of network IP
3	Connect the computers in Local Area Network.
4	Performing an Initial Switch Configuration using CISCO Packet Tracer
5	Configuring WEP on a Wireless Router using CISCO Packet Tracer
6	Planning Network-based Firewalls using CISCO Packet Tracer
7	Configure Virtual LANs using CISCO Packet Tracer
8	Configure DHCP server & Helper address feature in Cisco router using CISCO PacketTracer
9	Examining WAN Connections using CISCO Packet Tracer
10	Simulation of various Topologies using CISCO packet Tracer
11	Write a program in C for RSA
12	Examine packets of different protocols using Wireshark (Network Traffic Analysis and Filtering) using CISCO Packet Tracer
Text Books/Reference Books	
1	Data Communications and Networking, Forouzan,6th Edition, McGraw Hill, 2021 ISBN: **978-1260597820**
2	Computer Networking A Top-Down Approach – Kurose James F, Keith W, 7th Edition, Pearson, 2016.ISBN: 978-0133594140
3	Cryptography and Network Security - Principles and Practice, Stallings William,7th Edition Pearson, 2020, ISBN: 9780135764213
4	T. L. Singal, "Wireless Communications", Tata McGraw Hill, 2nd Edition, 2011
5	Introduction to Data Communication and Networking, Wayarles Tomasi, 1st edition Pearson Education, 2007, ISBN:0130138282
6	Understanding Communications and Networks, W. A. Shay, Cengage Learning. 3rd Edition,2008,BS Publications, ISBN: 978-0534950545
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

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COLLEGE OF ENGINEERING, PUNE

B.Tech.(Electronics and Tele-Communication Engineering) (2023 Course)

Minor Degree Programme:AI in Health Care

Sr. No	Category	Semester	Nameofthe Course	Teaching Scheme			ExaminationScheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Introduction to Biomedical Engineering	3	2	-	60	40	25	-	25	150	3	1	-	4
2.	MI	IV	Biomedical Instrumentation and Biosignal Processing	3	2	-	60	40	25		25	150	3	1	-	4
3.	MI	V	Introduction to Machine Learning	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	MI	VI	Advanced Artificial Intelligence for Healthcare Applications	3	2	-	60	40	25	-	25	150	3	1	-	4
5.	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

INTRODUCTION TO BIOMEDICAL ENGINEERING					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150Marks		
CoursePre-requisites: none					
Course Outcomes					
After completion of the course students would be able to:					
1	Describe the structure and function of cells, identify different types of biomolecules including proteins, nucleic acids, carbohydrates, and lipids				
2	Demonstrate an understanding of the basics of genetics and heredity, explain the structure process of DNA replication				
3	Apply knowledge of physiology and biochemistry to understand and interpret biological phenomena in living organisms				
4	Analyze the mechanical properties of biological tissues, evaluate the properties and design considerations of biomaterials used in biomedical applications,				
5	Analyze electrical, mechanical, and biochemical biosignals commonly used in healthcare monitoring				
6	Analyze ethical dilemmas and privacy concerns in biomedical engineering, evaluate the process of clinical validation and evaluation of biomedical systems				
Topics covered					
UNIT-I	**Cellular Biology and Biomolecules** Cell structure and function Biomolecules: proteins, nucleic acids, carbohydrates, lipids Cellular processes: metabolism, cellular respiration, photosynthesis Cellular communication and signaling			**(06 Hours)**	

UNIT-II	**Genetics and Molecular Biology** Basics of genetics and heredity DNA structure and replication Gene expression and regulation Molecular biology techniques: PCR, gene cloning, DNA sequencing	**(06 Hours)**
UNIT-III	**Physiology and Biochemistry** Overview of human physiology systems Biochemistry of physiological processes: enzymes, metabolism, cellular signaling Homeostasis and regulation of physiological parameters	**(06 Hours)**
UNIT-IV	**Biomechanics and Biomaterials** Principles of biomechanics: stress, strain, deformation Mechanical properties of biological tissues Biomaterials: properties, design considerations, applications Tissue engineering and regenerative medicine	**(06 Hours)**
UNIT-V	**Introduction to Biosignals** Principles of biosignal acquisition: electrodes, sensors, and transducers Overview of common biosignal acquisition methods (e.g., ECG, EEG, EMG) Factors influencing biosignal acquisition: noise, artifacts, electrode placement, Electrocardiography (ECG, Electroencephalography (EEG, Electromyography (EMG, Blood pressure measurement, Respiratory rate monitoring, Pulse oximetry, Blood glucose monitoring, Blood gas analysis, Biomarkers	**(06 Hours)**
UNIT-VI	**Ethical and Regulatory Considerations in Biomedical Engineering** Clinical Validation and Evaluation of Biomedical systems Privacy and security issues in healthcare data management Regulatory frameworks and compliance requirements for Biomedical systems Societal and Legal Implications	**(06 Hours)**
ProjectBasedLearning: Thestudents areexpectedtoperformaproject(inagroup) basedonthe courseand prepare areport for thesame.Thereport should be as per standardguidelines.		
Term Work: Thetermworkshallconsistofrecordofminimumeightexperiments performed by the student:		
1	Electrocardiography (ECG) Experiment	

2	Electroencephalography (EEG) Experiment
3	Electromyography (EMG) Experiment
4	Blood Pressure Measurement Experiment
5	Respiratory Rate Monitoring Experiment
6	Pulse Oximetry Experiment
7	Blood Glucose Monitoring Experiment
8	Blood Gas Analysis Experiment
Text Books/Reference Books	
1	"Molecular Biology of the Cell" by Bruce Alberts, Alexander Johnson, Julian Lewis
2	"Principles of Genetics" by D. Peter Snustad and Michael J. Simmons
3	"Principles of Physiology" by Robert M. Berne and Matthew N. Levy
4	"Biomaterials Science: An Introduction to Materials in Medicine" by Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen
5	"Introduction to Biomedical Engineering" by John Enderle, Joseph Bronzino, and Susan M. Blanchard
6	"Ethics and Regulatory Issues in Biotechnology" by L. F. Francis
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BIOMEDICAL INSTRUMENTATION AND BIOSIGNAL PROCESSING					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150Marks		

CoursePre-requisites: Introduction to Biomedical Engineering

Course Outcomes

After completion of the course students would be able to:

1	Understand the fundamental principles of biomedical instrumentation, including the design and operation of sensors, transducers, and data acquisition systems used in healthcare applications
2	Analyze various biosignal acquisition methods, such as electrocardiography (ECG), electroencephalography (EEG), electromyography (EMG), and medical imaging modalities, and evaluate their suitability for different healthcare scenarios
3	Apply signal processing techniques, including filtering, feature extraction, and analysis, to process and interpret biosignals for diagnostic and therapeutic purposes.
4	Design and implement biomedical instrumentation systems integrating biosignal processing techniques with artificial intelligence (AI) algorithms for personalized healthcare solutions.
5	Explore the diverse applications of biomedical instrumentation and biosignal processing, including wearable health monitoring devices, remote patient monitoring systems, and assistive technologies for individuals with disabilities
6	Evaluate the clinical significance of biomedical instrumentation and biosignal processing in healthcare, including diagnostic and therapeutic applications, through case studies and practical examples.

Topics covered

UNIT-I	**Introduction to Biomedical Instrumentation** Definition and scope of biomedical instrumentation Importance of biomedical instrumentation in healthcare Overview of biomedical sensors and transducers	**(06 Hours)**

	Signal conditioning and amplification techniques Introduction to data acquisition systems in biomedical engineering	
UNIT-II	**Biosignal Acquisition Methods** Principles of biosignal acquisition: electrodes, sensors, and transducers Overview of common biosignal acquisition methods (e.g., ECG, EEG, EMG) Factors influencing biosignal acquisition: noise, artifacts, electrode placement Techniques for biosignal acquisition in different healthcare scenarios	**(06 Hours)**
UNIT-III	**Biosignal Processing Techniques** Basics of biosignal processing: filtering, feature extraction, and analysis Time-domain and frequency-domain analysis of biosignals Advanced signal processing techniques in biosignal analysis Integration of biosignal processing with machine learning for healthcare applications	**(06 Hours)**
UNIT-IV	**Biomedical Imaging Techniques** Principles of medical imaging modalities: X-ray, CT, MRI, ultrasound Image processing techniques for medical image analysis Computer vision applications in medical imaging and diagnostics Integration of medical imaging with biosignal processing for diagnosis and treatment planning	**(06 Hours)**
UNIT-V	**Applications of Biomedical Instrumentation and Biosignal Processing** Wearable health monitoring devices and their applications Remote patient monitoring systems and telemedicine Assistive technologies for individuals with disabilities Integration of biosignal processing with AI for personalized healthcare solutions	**(06 Hours)**
UNIT-VI	**Clinical Applications of Biomedical Instrumentation and Biosignal Processing** Clinical significance of biosignal processing in healthcare Diagnostic applications of biomedical instrumentation Therapeutic applications of biosignal processing	**(06 Hours)**

	Case studies on the integration of biosignal processing with AI in clinical settings Challenges and future directions in clinical applications of biomedical instrumentation and biosignal processing	
ProjectBasedLearning: Thestudents areexpectedtoperformaproject(inagroup) basedonthe Course and prepare are port for the same. The report should be as per standard guidelines.		
Term Work: The term work shall consist of record of minimum eight experiments performed by the student:		
1	Acquire ECG signals using electrodes, process the signals to remove noise and artifacts, and analyze the signals for diagnostic purposes	
2	To process EEG signals to detect brainwave patterns and analyze their characteristics	
3	To perform ultrasound imaging of a biological sample and process the images for diagnostic purposes	
4	To measure blood pressure using a sphygmomanometer and analyze the signals for diagnostic purposes	
5	To acquire EMG signals from muscles, process the signals to remove noise, and analyze them to assess muscle activity.	
6	To design and develop a wearable health monitoring device for remote patient monitoring	
7	To analyze biosignal data collected from various sources and visualize the data for healthcare insights.	
8	To simulate real-world biomedical signal processing scenarios using software tools.	
Text Books/Reference Books		
1	"Biomedical Signal Processing: Principles and Techniques" by D.C. Reddy and P.C. Deshmukh	
2	"Introduction to Biomedical Engineering" by John Enderle, Joseph Bronzino, and Susan M. Blanchard	
3	"Biomedical Instrumentation: Technology and Applications" by R.S. Khandpur	
4	"Biomedical Signal Analysis: A Case-Study Approach" by Rangaraj M. Rangayyan	
5	"Principles of Medical Imaging" by Avinash C. Kak and Malcolm Slaney	

6	"Biosignal and Biomedical Image Processing: MATLAB-Based Applications" by John G. Semmlow
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

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COLLEGE OF ENGINEERING, PUNE

B. Tech. (Mechanical Engineering) (2023 Course)

Minor Degree Programme I : 3D Printing

Sr. No	Category	Semester	Name of the Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Materials & Manufacturing Processes for 3D Printing	3	2	-	60	40	25	-	25	150	3	1	-	4
2.	MI	IV	Modelling for 3D Printing	3	2	-	60	40	25		25	150	3	1	-	4
3.	MI	V	3D Printing Technology & Processes	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	MI	VI	Design for Additive Manufacturing	3	2	-	60	40	25	-	25	150	3	1	-	4
5.	MI	VI	**Project**	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

MATERIALS & MANUFACTURING PROCESSES FOR 3D PRINTING					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites:

The students should have knowledge of

- Knowledge of basic concepts of Physics and chemistry
- Basic knowledge of Engineering materials and their properties
- Basic knowledge of cutting tools
- The students should have knowledge of

Course Outcomes

After completion of the course students would be able to:

1	Understand basics of Engineering material and its characteristics
2	Understand the concept of powder metallurgy and apply in manufacturing components.
3	Understand the various casting processes and apply the best casting process for a specific product.
4	Understand different operations of Lathe, Drilling and Milling machine and apply them to create the job.
5	Understand various grinding machines and plastic moulding machines and apply them to create the shape.
6	Understand the various additive manufacturing and apply them for manufacturing components.

Topics covered

UNIT-I	**Study of Engineering materials and their properties** Classification of Engineering materials, Introduction to ferrous and non-ferrous materials, Study of plastics and polymers, elastomers rubbers. Ceramic	**(06 Hours)**

	materials, study of composite materials. Mechanical properties of different materials	
UNIT-II	**Introduction to Powder Metallurgy** Introduction to Powder Metallurgy, Advantages and limitations of powder metallurgy, Production of metals powder, Characteristics of powder, Powder conditioning, Powder Compacting, Hot compacting methods, Sintering and sintering furnaces.	**(06 Hours)**
UNIT-III	**Casting Processes** Introduction to casting, Pattern and pattern making, Core and core making-– Introduction, Core making Procedure, Types of cores, Core print, Core boxes. Mould and mould making- Moulding Methods. Sand Casting, Pressure and gravity die casting, Shell mould casting, Investment casting, Continuous casting, centrifugal casting, Applications, Merits and limitations.	**(06 Hours)**
UNIT-IV	**Machining Processes** Lathe Machines: Introduction, function, types, construction, accessories, operations. Drilling Machines: Fundamentals of drilling process Milling Machines: Fundamentals of milling process, cutters-types and geometry, Operations performed on milling machines. Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines, CNC controllers. CNC Programming: Coordinate system, structure of a part program, G & M Codes.	**(06 Hours)**
UNIT-V	**Abrasive Machining Processes, Plastics & Plastic Moulding** **Abrasive Machining Processes:** Abrasive machining, abrasives -types, size and geometry, Grinding, grinding wheels. Types of grinding machines. **Plastics & Plastic Moulding:** Moulding characteristics of plastic, Moulding process- compression, transfer and injection blow moulding. Mould design- Materials and construction, bulk factor, shrinkage, moulding parameters, moulding machines, extruders.	**(06 Hours)**
UNIT-VI	**Additive Manufacturing** Introduction to Additive manufacturing, Different types of Additive manufacturing processes,3 D Printing technology, FDM and SLA processes, working principle, Applications, introduction to Stereo lithography Apparatus,	**(06 Hours)**

	Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Overview & Introduction of AM.	

Project Based Learning: The students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.

Term Work: The term work shall consist of a record of a minimum of eight experiments performed by the student:

1	Testing of mechanical properties such as Tensile strength
2	Testing of Hardness and impact strength
3	Demonstration and Practical powder compacting processes
4	Demonstration and Practical casting processes
5	Study on lathe and other machining processes
6	Demonstration and Practical on milling and drilling
7	Demonstration and Practical grinding operations
8	Demonstration and Practical on plastic molding.
9	Demonstration and Practical 3D printing

Textbooks/Reference Books

1	Material Science and Engineering", R K Rajput S K Kataria and Sons Publication, Delhi.
2	P. C. Sharma, Production Engineering, S. Chand Publications
3	R. K. Jain, Production Technology, Khanna Publishers
4	P.Radhakrishnan,V.Raju, CAD/CAM/CIM, New Edge international Publishers.
5	P. N. Rao, Manufacturing Technology- Vol 1, McGraw Hill Education (India) Private Limited
6	P. N. Rao, Manufacturing Technologyp, Vol- II, McGraw Hill Education (India) Private Limited
7	B. S. Raghuwanshi, Workshop Technology, Vol-II, Dhanpat Rai & Co.
8	Additive Manufacturing Technologies (Authors: Ian Gibson, David Rosen , Brent Stucker , Mahyar Khorasani)

Syllabus for Unit Test:

Unit Test I : Units I, II, and III

Unit Test II : Units IV, V, and VI

MODELLING FOR 3D PRINTING					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites:

The students should have knowledge of

- Solid Modeling
- Machine design and Analysis
- Computer Aided Machine Drawing

Course Outcomes

After completion of the course students would be able to:

1	Understand the concepts of additive manufacturing and 3D printing.
2	Understand the basic concept of machine component design.
3	Understand concept of geometric dimensioning and tolerancing and apply in machine drawing for 3D printing.
4	Understand the concept of detail and assembly drawing.
5	Creating 2D drawing of machine components using modeling software.
6	Creating 3D drawing of machine component using modeling software and understand the concepts for data preparation for 3D printing.

Topics covered

UNIT-I	**Introduction to 3D Printing** Introduction to 3D printing, Definition, 3D Printer, 3D Printing Technology, Process of 3D printing, Applications of 3D Printing, 3D Printing examples, 3D Printing advantages Additive manufacturing, Photopolymerization, 3D slicing, STL file configuration	**(06 Hours)**
UNIT-II	**Design of components for 3D printing**	**(06 Hours)**

	Introduction to machine design, Design procedure, Design consideration for casting, forging and machining, Design for manufacture and assembly. Selection of material.	
UNIT-III	**Geometric Dimensioning and Tolerancing (GD & T)** Limit, Fit and tolerances: Introduction, fundamental tolerances, deviations, methods of placing limit dimensions, types of fits with symbols and applications, Geometric tolerance on drawing.	**(06 Hours)**
UNIT-IV	**Assembly and Details Drawing** Introduction to unit assembly drawing, steps involved in preparing assembly drawing from details and vice versa. Types of drawing: Machine drawing, production drawing, drawing for catalogue. Drawing standards.	**(06 Hours)**
UNIT-V	**Drawing for 3D printing using CAD software** Sketch Entities, Sketch Tools, Block, Relation and Dimensioning, fully defined, Over defined, under defined drawing. Part Modelling Tools, Features: Extrude, Revolve, Swept, Loft. Creating Reference, curves, Fillet features, Inserting Hole types, Creating Chamfer, Shell, rib, pattern and advanced modelling tools	**(06 Hours)**
UNIT-VI	**Part Modelling using CAD software** Part Modelling Tools, creating curves, Fillet features, Inserting Hole types, Creating Chamfer, Shell, rib, pattern and advanced modelling tools. Data Preparation for 3D Printing: 3D Printing interfaces, STL interface Specification, Creating STL file, Repair of STL files, STL data Manipulation-Advantages and limitations of STL file format. Part orientation and support generation-Model Slicing and Contour Data organization, Direct and adaptive slicing: Identification of peak features-Tool Path generation.	**(06 Hours)**
Project Based Learning: The students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.		
Term Work: The term work shall consist of eight experiments performed by the student:		
1	Case study on 3D printing technology, Type of 3D Printer.	
2	Detail assignment on basic design concepts.	

3	Problems based on limit, fit and tolerances.
4	Detail to assembly drawing of simple machine components.
5	Assembly to detail drawing of simple machine components.
6	Sketcher drawings using Solid Modeling software
7	Part modelling using Solid Modeling software.
8	Data preparation for 3D printing for a simple machine component.
Textbooks/Reference Books	
1	Ibrahim Zeid and R. Siva-Subramaniam – "CAD/CAM- Theory and Practice", Tata McGraw Hill, Publishing Co. 2009.
2	Kumar, L. J., Pandey, P. M., & Wimpenny, D. I. (Eds.). (2019). 3D printing and additive manufacturing technologies (Vol. 311). Singapore: Springer.
3	Rao P. N., "CAD/CAM", Tata McGraw Hill.
4	Foley, Van Dam, Feiner and Hughes, "Computer Graphics Principles and Practice", Second edition, Addison– Wesley, 2000.
5	Martenson, E. Micheal, "Geometric Modelling", John Wiley & Sons, 1995.
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

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COLLEGE OF ENGINEERING, PUNE

B.Tech. (Mechanical Engineering)(2023 Course)

Minor Degree Programme II : Energy Engineering

Sr. No	Category	Semester	Name of the Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Fundamentals of Energy Engineering	3	2	-	60	40	25	-	25	150	3	1	-	4
2.	MI	IV	Non-Renewable Energy Technologies	3	2	-	60	40	25		25	150	3	1	-	4
3.	MI	V	Renewable Energy Technologies	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	MI	VI	Energy Audit and Management	3	2	-	60	40	25	-	25	150	3	1	-	4
5.	MI	VI	**Project**	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**-**	**240**	**160**	**150**	**-**	**150**	**700**	**12**	**8**	**-**	**20**

FUNDAMENTALS OF ENERGY ENGINEERING

Teaching Scheme		Examination Scheme		Credits Allotted	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites:

The students should have knowledge of

Engineering Mathematics.

Engineering Physics.

Course Outcomes

After completion of the course students would be able to:

1	Understand concepts of first law of thermodynamic and its application.
2	Understand concepts second law of thermodynamics, entropy and availability.
3	Apply the knowledge of Properties of steam for different vapor Processes.
4	Apply the knowledge of properties of steam for different power cycles.
5	Understand the different air standard cycles and analyze it.
6	Understand the different type of fuels, concepts of combustion and analyze exhaust gas composition.

Topics covered

UNIT-I	**Laws of Thermodynamics** Thermodynamics-introduction, energy and work transfer, zeroth law of thermodynamics, statement of first law of thermodynamics, Joule's experiment, Applications of first law to flow and non-flow processes. Steady flow energy equation and its applications to different devices. Perpetual Motion Machine of first kind (PMM-I). Limitations of first law of thermodynamics.	**(06 Hours)**

	Kelvin-Planck's statement & Clausiu's statements for 2nd law of thermodynamics, Heat engine, refrigerator and heat pump, Perpetual Motion Machine of second kind (PMM-II), Carnot cycle & Carnot heat engine.	
UNIT-II	**Properties of Fluids and Gas Processes** Definition of fluid, fluid properties *viz.* mass density, specific weight, specific volume, specific gravity, viscosity, vapor pressure, compressibility, elasticity, surface tension and capillarity. Equation of state. Non flow and steady flow gas processes, Constant pressure process, Constant volume process, Constant temperature process, Isentropic process, Polytrophic process, Hyperbolic process, work transfer & heat transfer during various processes.	**(06 Hours)**
UNIT-III	**Introduction to Heat Transfer** Statement and explanation of Fourier's law of heat conduction. Conducting and insulating materials and their properties. Composite slab, Electrical analogy. Newton's law of cooling, Natural and forced convection- applications. Types of fins. Heat exchangers classification and applications. Stefan Boltzmann's law. Concept of shape factor.	**(06 Hours)**
UNIT-IV	**Energy Producing Devices** Internal Combustion Engines: Two stroke, Four Stroke Cycles, Construction and working of C.I. and S.I. Engines. Modern trends in IC engines. Impulse momentum principle, Impact of jet, Hydraulic turbines: Impulse & reaction water turbines. Steam turbines and gas turbines: Impulse & reaction. Steam generators. (Theoretical study using schematic diagrams)	**(06 Hours)**
UNIT-V	**Energy Absorbing Devices** Vapor compression and vapor absorption refrigeration system, house hold refrigerator, window air conditioner. Reciprocating and rotary compressors and pumps, Blowers, Fans (Theoretical study using schematic diagrams)	**(06 Hours)**
UNIT-VI	**Introduction to Energy Technologies** Renewable and nonrenewable, solar flat plate collector, Wind, Geothermal, Wave, Tidal, Hydro power, Biogas, Bio-Diesel, Nuclear power. (Theoretical study using schematic diagrams), Current Energy Scenario.	**(06 Hours)**
Project Based Learning: The **s**tudents are expected to perform a project (in a group) based on the		

course and prepare a report for the same. The report should be as per standard guidelines.	
Term Work: The term work shall consist of a record of a minimum of eight experiments performed by the student:	
1	To demonstrate steady flow energy equation for engineering applications such as heat exchangers, turbo machinery, boiler, etc.
2	To determine viscosity of fluid.
3	To demonstrate second law of thermodynamic through real life application. (Kelvin-Planck's statement)
4	Demonstration of the second law of thermodynamic through real life application. (Clausius statement)
5	Demonstration of Two stroke and Four stroke engines
6	Demonstration of pumps and compressor
7	Study of domestic refrigerator & window air-conditioner
8	Study and trial on Bomb calorimeter
9	Trial on Vapor Compression Refrigeration systems
Textbooks/Reference Books	
1	V. P. Vasandani and D. S. Kumar, Heat Engineering Metropolitan Book Company, New Delhi.
2	R S Khurmi and J K Gupta, Textbook of Thermal Engineering, S Chand publications.
3	P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications.
4	Y. A. Cengel & M.A. Boles, Thermodynamics -An engineering approach, Tata McGraw Hill Publications.
6	R. K. Rajput, Engineering Thermodynamics, Laxmi Publications.
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

NON-RENEWABLE ENERGY TECHNOLOGIES					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites:

The students should have knowledge of

- Mechanical Engineering System.
- Thermodynamic principals
- Thermodynamic Applications

Course Outcomes

After completion of the course students would be able to:

1	Understand fundamentals of Boilers
2	Understand fundamentals of Thermal Power Plant
3	Understand fundamentals of Gas Power Plants
4	Understand the fundamentals of Nuclear power plants.
5	Understand fundamentals of heat exchangers
6	Understand study fundamentals of Power Plant Economics.

Topics covered

UNIT-I	**Boiler Mountings and Accessories** Introduction, Classification of boilers, Features of Low- and high-pressure boiler, construction and working of boilers, Fluidize bed combustion, boiler mountings and Accessories. Heat balance analysis.	**(06 Hours)**
UNIT-II	**Steam Power Plant** Introduction, Steam Power Plant, Thermal Power Plant, Construction and Working, Role of	**(06 Hours)**

	thermal power plant in current power generation scenario, Selection site for thermal power plant. Basic Rankine cycle	
UNIT-III	**Gas Turbine Power Plant** Introduction, Components of Gas Turbine Power plants, Simple gas turbine power Plant, Classification of Gas turbines, Advantages of Gas turbine, Brayton cycle, Jet Engines	**(06 Hours)**
UNIT-IV	**Nuclear Power Plant** Basic Principles of Nuclear Energy, Nuclear reactor, Nuclear Power Plants, Nuclear power- Radio activity, Working of a nuclear power plant, PWR, BWR and gas cooled reactors, Advantages and Disadvantages of Nuclear power plant.	**(06 Hours)**
UNIT-V	**Heat Exchangers used in Power Plants and Instrumentation** Classification of Heat Exchangers, Types of Condensers, Types of Cooling Tower, Construction and Working, Advantages and Disadvantages. Instruments: Drum level Controls, Main Steam Temperature Control, Combustion Control, Measuring Instruments (Temperature, pressure, Velocity , Fluid flow)	**(06 Hours)**
UNIT-VI	**Power Plant Economics** Power Plant Economics - Cost of electric energy, fixed and operating costs, energy rates, types of tariffs, economics of load sharing, Load Curves, Load duration Curves, types of load and their characteristics, performance and operational characteristics of power plants, comparison of various power plants, Energy, Economic and Environmental issues of Power plants, Emission norms for power plants.	**(06 Hours)**
Project Based Learning: The **s**tudents are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.		
Term Work: The term work shall consist of a record of a minimum of eight experiments performed by the student:		
1	Study of Different types of boilers	

2	Study of Boiler Mountings and Accessories
3	Study of Steam Power Plant
4	Study of Thermal Power Plant
5	Study of Nuclear power plant
6	Study of Power plant Instrumentation.
7	Study of Heat Exchangers used in Power Plant
8	Visit to power plant.
9	Case Study on Plant Safety and Maintenance
10	Case Study on Economic and Environmental issues of Power plants
Textbooks/Reference Books	
1	Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.
2	John V Grimaldi and Rollin H Simonds, Safety Management
3	M. M. El Wakil, Power Plant Technology –Mc Graw Hill. Int. Edition.
4	Domkundwar and Arora, Power Plant Engineering, Dhanpatrai and Sons.
5	Grainger John J, and Stevenson Jr. W.D. Power System Analysis, McGraw Hill 1994
6	L. K. Kirchmeyer, Economic Operation of Power Systems, John Wiley and Sons, 1993.
7	C. A. Gross, Power System Analysis, John Wiley and Sons, Inc.1986.
8	John Weisman & L.E. Eckart, Modern Power Engineering, Prentice Hall, 1985
9	P. K. Nag, Power plant Engineering, TMH, 3rd Edition 2002
10	S. P. Sukhatme, Solar Energy, Tata McGraw Hill, 3rdEdition 1996.
11	G. D. Rai, Non-Conventional Energy Sources, Khanna Publishers, 2011
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BHARATI VIDYAPEETH

(DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (Robotics & Automation Engineering) (2023 Course)

Minor Degree Programme I : Robotics

Sr. No	Category	Semester	Name of Course	Teaching Scheme			Examination Scheme (Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	TH	PR /OR	Tut	Total
1.	MI	III	Fundamentals of Robotics	3	2	0	60	40	25	-	25	125	3	1	-	4
2.	MI	IV	Instrumentation for Robotics and Automation	3	2	0	60	40	25	-	25	125	3	1	-	4
3.	MI	V	Robotics Simulation	3	2	0	60	40	25	-	25	125	3	1	-	4
4.	MI	VI	Industrial Robotics and Drone Technology	3	2	0	60	40	25	-	25	125	3	1	-	4
5.	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**0**	**240**	**160**	**150**	**0**	**150**	**700**	**12**	**8**	**0**	**20**

FUNDAMENTALS OF ROBOTICS					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: The students should have knowledge of

Basic knowledge of higher secondary Physics

Basic knowledge of Mathematics

Course Outcomes

After completion of the course students would be able to:

1	Understand the basic components and configurations of robots.
2	Understand different types of grippers and apply them based on applications.
3	Understand the robot drive systems.
4	Understand the fundamentals of sensors and apply them based on application.
5	Understand the robot control systems.
6	Understand the applications of robots in various fields.

Topics covered

UNIT-I	**Introduction to Robotics** History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Robot Joints, Robot Anatomy, Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Basic Configuration of Robots.	**(06 Hours)**
UNIT-II	**Robot Grippers** Introduction to End effectors. Consideration in selection of grippers, Types of grippers, Mechanical Grippers, Hooks and Scoops, Magnetic Grippers, Vacuum Grippers, Expandable Bladder Type Grippers, Adhesive Grippers. Specifications of robots. Industrial Robots in Manufacturing trial robot's specifications. Selection based on the Application.	**(06 Hours)**

UNIT-III	**Robotics Drives Systems** Introduction, Functions of drive systems, Hydraulic actuators- Linear Hydraulic actuators and Rotary Hydraulic actuators. Pneumatic Actuators- Linear Pneumatic actuators and Rotary Pneumatic actuators. Electric Actuators-D.C. Motor, Reversible A.C. Motors, Brushless D.C. Motors, D.C. Servomotors, A.C. Servomotors, Stepper Motors.	**(06 Hours)**
UNIT-IV	**Fundamentals of Industrial Fluid Power Systems** Components of fluid power system, advantages and limitations. Difference between electrical, pneumatic and fluid power systems. Seals, sealing materials. Types of pipes, hoses, material. ISO symbols for hydraulic and pneumatic Components	**(06 Hours)**
UNIT-V	**Robot Path Planning** Robot controls-Point to point control, Continuous path control, Intelligent robot, Control system for Robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Control architecture-position, path velocity, and force control systems.	**(06 Hours)**
UNIT-VI	**Applications for Robots** Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, and robot for underwater applications. material handling, Robotics and Automation for Industry 4.0, Applications in unmanned systems, defense, medical, biomedical, industries, Co-bot etc.	**(06 Hours)**

Project Based Learning: The students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.

Term Work: The term work shall consist of a record of a minimum of eight experiments performed by the student:

1	To study an introduction to basic components of Robot.
2	To study an introduction to Robot configuration
3	Introducing different types of robotics and demonstrating them to identify different parts and components.
4	To study and demonstrate various robotics sensors.
5	To study and demonstrations of Hydraulic actuators.
6	To study and demonstrations of Pneumatic actuators.

7	To study and demonstrations of Electric actuators.
8	Two Case Studies of Applications in Industry
9	Introduction and general considerations in robot applications.
Textbooks/Reference Books	
1	Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta,
2	“Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
3	Craig. J. J. “Introduction to Robotics- mechanics and control”, Addison- Wesley, 1999.
4	S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
5	Richard D. Klafter, Thomas. A , Chri Elewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning. 2009.
6	Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
7	P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing Company Ltd., 1995.
8	Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008.
9	Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987
10	Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

INSTRUMENTATION FOR ROBOTICS AND AUTOMATION					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: The students should have knowledge of

Knowledge of Mathematics, Physics, basics of robotics

Knowledge of Basic Electrical and Electronics

Course Outcomes

After completion of the course students would be able to:

1	Understand & apply fundamentals of instrumentation to robotics and automation
2	Understand concepts of sensors and apply it for robotics applications
3	Understand concepts of PLC and Develop ladder diagram for industrial applications.
4	Understand concepts related to control systems and Control actions
5	Understand concepts related to totally integrated automation and identify such systems
6	Understand the concept of SCADA System and able to develop its applications in the field of robotics

Topics covered

UNIT-I	**Fundamentals of Sensors and Transducers** Different types of sensors and their working principles (e.g., piezoelectric, capacitive, inductive, optical, etc.). Sensor characteristics such as accuracy, precision, resolution, sensitivity, and dynamic range. Signal conditioning techniques for amplifying, filtering and converting sensor signals, Principles of analog-to-digital conversion (ADC) and digital-to-analog conversion (DAC), Different types of DAQ systems and their specifications, Interfacing sensors with DAQ systems	**(06 Hours)**
UNIT-II	**Robot Grippers** Position and Motion Sensors: encoders, potentiometers, accelerometers,	**(06 Hours)**

	gyroscopes, LiDAR, vision systems. Force and Torque Sensors: Touch Sensor, strain gauges, piezoelectric sensors, force-torque sensors. Environmental Sensors: temperature, pressure, humidity, proximity, flow sensors, velocity, light. Other Sensors: chemical sensors, acoustic sensors, tactile sensors, Robotic vision sensor	
UNIT-III	**Programmable Logic Controller (PLC)** Introduction to PLCs, Basic Structure of a PLC, Principles of Operation, PLC Programming Languages, Ladder diagram, Latching and internal relays, Timers and Counters, Selection of a PLCs, Application of PLCs. Broad classes of industrial automation and their comparative study, Automation Principles and Strategies, USA Principle, Ten Strategies for Automation and production systems, Automation Migration Strategy	**(06 Hours)**
UNIT-IV	**Automatic Control Systems and Control Actions** **Introduction to control systems:** Mechatronics system & its examples, mechatronics system components. Open loop and closed loop system, effects of feedback and basic characteristic of feedback control systems, classification of control systems. **Introduction to Controllers:** Control System Parameters, Controller Modes, Control Actions, Types of Controllers-ON-OFF Controller, Proportional Controller (P-Controller), Proportional + Integral Controller (P-I Controller), Proportional + Derivative Controller (P-D Controller), Proportional + Integral + Derivative Controller (P-I-D Controller).	**(06 Hours)**
UNIT-V	**Totally Integrated Automation (TIA)** Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure. Necessity and Role in Industrial Automation, Need for HMI systems. Types of HMI	**(06 Hours)**
UNIT-VI	**Supervisory Control and Data Acquisition (SCADA)** Overview Developer and runtime packages, architecture, Tools, Tag, Internal & External graphics, Alarm logging, Tag logging, structured tags, Trends, history, Report generation, SCADA applications, DCS Architecture, Case studies of Machine automation, Process automation, Comparison between SCADA and DCS	**(06 Hours)**
Project Based Learning: The students are expected to perform a project (in a group) based on the		

course and prepare a report for the same. The report should be as per standard guidelines.	
Term Work: The term work shall consist of a record of a minimum of eight experiments performed by the student:	
1	Study of P, P+I, P+D, P+I+D control actions using any trainer kit / simulation software.
2	To study working of servomotor and its applications in industrial automation.
3	To study working of variable frequency drive and its applications in industrial automation.
4	Study of Analog to Digital Convertor (ADC)
5	Study of Digital to Analog Convertor (DAC)
6	Study of Data Acquisition System (DAS)
7	Study of PLC, SCADA and development of ladder logic for various industrial applications.
8	Study of distributed control systems and its applications.
9	Study of various types of sensors used in robotic systems.
Textbooks/Reference Books	
1	Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta,
2	“Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
3	Craig. J. J. “Introduction to Robotics- mechanics and control”, Addison- Wesley, 1999.
4	S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
5	Richard D. Klafter, Thomas. A , Chri Elewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning. 2009.
6	P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing Company Ltd., 1995.
7	Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

BHARATI VIDYAPEETH

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COLLEGE OF ENGINEERING, PUNE

B. Tech. (Robotics & Automation Engineering) (2023 Course)

Minor Degree Programme II : Industry 5.O

Sr. No	Category	Semester	Name of the Course	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MI	III	Fundamentals of Manufacturing Systems	3	2	0	60	40	25	-	25	125	3	1	-	4
2.	MI	IV	Smart Manufacturing and Management Systems	3	2	0	60	40	25	-	25	125	3	1	-	4
3.	MI	V	Industry 4.O and IOT	3	2	0	60	40	25	-	25	125	3	1	-	4
4.	MI	VI	Industry 5.O and its applications	3	2	0	60	40	25	-	25	125	3	1	-	4
5.	MI	VI	Project	-	4	-	-	-	50	-	50	100	-	4	-	4
			Total	**12**	**12**	**0**	**240**	**160**	**150**	**0**	**150**	**700**	**12**	**8**	**0**	**20**

FUNDAMENTALS OF MANUFACTURING SYSTEMS					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: The students should have knowledge of

- Knowledge of basic concepts of Physics and chemistry
- Basic knowledge of Engineering materials and their properties
- Basic knowledge of engineering company

Course Outcomes

After completion of the course students would be able to:

1	Understand basics of casting manufacturing processes its characteristics
2	Understand different operations of Lathe, Drilling and Milling machine and apply ther create the job
3	Understand the concept of powder metallurgy and apply in manufacturing of components
4	Understand the various rolling processes and apply the best rolling process for a specific product.
5	Understand various grinding machines and plastic moulding machines and apply them to create the shape.
6	Understand the various CNC Programming and apply them for manufacturing components.

Topics covered

UNIT-I	**Study of Casting Processes** Introduction to casting, Pattern and pattern making, Core and core making-– Introduction, Core making Procedure, Types of cores, Core print, Core boxes. Mould and mould making- Moulding Methods. Sand Casting, Pressure and gravity die casting, Shell mould casting, Investment casting, Continuous	**(06 Hours)**

	casting, centrifugal casting, Applications, Merits and limitations.	
UNIT-II	**Machining Processes** Lathe Machines: Introduction, function, types, construction, accessories, operations. Drilling Machines: Fundamentals of drilling process, twist drill geometry, tool holders, Types of drilling machines, drilling operations. Milling Machines: Fundamentals of milling process, cutters-types and geometry, Operations performed on milling machines. Dividing head, methods of indexing.	**(06 Hours)**
UNIT-III	**Introduction to Powder Metallurgy and Welding technology** Introduction to Powder Metallurgy, Advantages and limitations of powder metallurgy, Production of metals powder, Characteristics of powder, Powder conditioning, Powder Compacting, Hot compacting methods, Sintering and sintering furnaces, Introduction to welding and welding processes.	**(06 Hours)**
UNIT-IV	**Introduction to Rolling Forging and Extrusion** Rolling processes, Types of rolling, its applications , close die forging and open die forging its applications, extrusion and other forming processes.	**(06 Hours)**
UNIT-V	**Abrasive Machining Processes, Plastics & Plastic Moulding** **Abrasive Machining Processes:** Abrasive machining, abrasives -types, size and geometry, Grinding, grinding wheels, Types of grinding machines, **Plastics & Plastic Moulding:** Moulding characteristics of plastic, Moulding process- compression, transfer and injection blow moulding. Mould design-Materials and construction, bulk factor, shrinkage, moulding parameters, moulding machines, extruders.	**(06 Hours)**
UNIT-VI	**CNC Technology** Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning Centre, machining Centre, , CNC controllers. CNC Programming: Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation.	**(06 Hours)**
Project Based Learning: The students are expected to perform a project (in a group) based on the		

course and prepare a report for the same. The report should be as per standard guidelines.	
Term Work: The term work shall consist of a record of experiments performed by the student:	
1	Demonstration and Practical on casting processes
2	Demonstration and Practical welding processes
3	Demonstration and Practical casting processes
4	Study on lathe and other machining processes
5	Demonstration and Practical on milling and drilling
6	Demonstration and Practical grinding operations
7	Demonstration and Practical on plastic molding.
8	Demonstration and Practical on casting processes
Textbooks/Reference Books	
1	"Material Science and Engineering", R K Rajput S K Kataria and Sons Publication, Delhi.
2	P. C. Sharma, Production Engineering, S. Chand Publications
3	R. K. Jain, Production Technology, Khanna Publishers
4	P. Radhakrishnan, V. Raju, CAD/CAM/CIM, New Edge international Publishers.
5	P. N. Rao, Manufacturing Technology- Vol 1, McGraw Hill Education (India) Private Limited
6	P. N. Rao, Manufacturing Technology, Vol- II, McGraw Hill Education (India) Private Limited
7	B. S. Raghuvanshi, Workshop Technology, Vol-II, Dhanpat Rai & Co.
8	E. P. DeGrom, J. T. Black and A. Kosher, Material and processes in manufacturing, PHI
9	HMT Handbook, Production Technology, TMH
10	"Material Science and Physical Metallurgy", Dr. V. D Kodgere, Everest Publication, Pune.
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

SMART MANUFACTURING SYSTEM AND MANAGEMENT					
Teaching Scheme		**Examination Scheme**		**Credits Allotted**	
Theory	: 03 Hours/Week	End Semester Examination	: 60 Marks	Theory	: 03
Practical	: 02 Hours/Week	Internal Assessment	: 40 Marks	Practical	: 01
Total	: 05 Hours /Week	Term-work	: 25 Marks	Total Credits	: 04
		Oral	: 25 Marks		
		Total	: 150 Marks		

Course Pre-requisites: The students should have knowledge of

- Knowledge of basic concepts of Physics and chemistry
- Basic knowledge of manufacturing processes
- Basic knowledge of engineering materials

Course Outcomes

After completion of the course students would be able to:

1	Understand basics of 3D printing and its characteristics
2	Understand different operations on industrial automations and apply them to create the job
3	Understand the concept of CAD/CAM and apply in manufacturing of components
4	Understand the various flexible manufacturing processes and apply the best process for a specific product.
5	Understand different project management knowledge areas and apply them in manufacturing industries
6	Understand the project planning and scheduling tools and techniques and apply them for manufacturing components.

Topics covered

UNIT-I	**Study of advanced manufacturing processes** Introduction to micro machining, non-traditional machining, ultrasonic and electron beam machining, 3D printing technology, different types of additive manufacturing, Applications, Merits and limitations.	**(06 Hours)**
UNIT-II	**Robot Grippers** Position and Motion Sensors: encoders, potentiometers, accelerometers, gyroscopes, LiDAR, vision systems. Force and Torque Sensors: Touch Sensor,	**(06 Hours)**

	strain gauges, piezoelectric sensors, force-torque sensors. Environmental Sensors: temperature, pressure, humidity, proximity, flow sensors, velocity, light. Other Sensors: chemical sensors, acoustic sensors, tactile sensors, Robotic vision sensor	
UNIT-III	**Industrial Automations** Introduction to Industrial Automation: Definition and scope of industrial automation. Evolution of automation in industries. Sensors and Actuators: Types of sensors and Actuators and their applications. Programmable Logic Controllers (PLCs): Robotics in Industrial Automation: Introduction to industrial robots. Robot kinematics and dynamics. Robot programming methods (teach pendant, offline programming, etc.). Applications of robots in manufacturing and automation.	**(06 Hours)**
UNIT-IV	**Introduction to flexible manufacturing** Introduction to Flexible Manufacturing Systems, Challenges of traditional manufacturing in a dynamic market, FMS architecture: workstations, material handling systems, Computer control, systems: supervisory control, part programming, and data management, Principles and applications of GT, Production planning concepts: capacity planning, material requirements planning (MRP), and Just-in-Time (JIT) in FMS.	**(06 Hours)**
UNIT-V	**Totally Integrated Automation (TIA)** Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure. Necessity and Role in Industrial Automation, Need for HMI systems. Types of HMI	**(06 Hours)**
UNIT-VI	**Project Management** Project management associations, Project management Process, Project Lifecycle, Feasibility Studies, Steps in Risk Management, Project cost estimating methods, Resource allocation	**(06 Hours)**
Project Based Learning: The students are expected to perform a project (in a group) based on the course and prepare a report for the same. The report should be as per standard guidelines.		
Term Work: The term work shall consist of a record of a minimum of eight experiments performed by the student:		
1	Demonstration and Practical on 3 D printing and additive manufacturing	

2	Demonstration and Practical use of robot in manufacturing
3	Draw 2-D sketching with geometrical and dimensional constraints using any commercially used solid modeling software.
4	Draw 3d solid modelling of the parts of a machine using any commercially used solid modeling software
5	Case study on project life cycle.
6	Creating Gantt chart and allocation of resources in project management software
7	Case study on project scheduling
8	Case study on project risk management.
Textbooks/Reference Books	
1	Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)": 5the Revised edition (1 January 2013)
2	Harold Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and controlling paperback": Wiley: tenth edition (20 November 2012)
3	P. C. Sharma, Production Engineering, S. Chand Publications
4	R. K. Jain, Production Technology, Khanna Publishers
5	P. Radhakrishnan, V. Raju, CAD/CAM/CIM, New Edge international Publishers.
6	P. N. Rao, Manufacturing Technology- Vol 1, McGraw Hill Education (India) Private Limited
7	P. N. Rao, Manufacturing Technology, Vol- II, McGraw Hill Education (India) Private Limited
8	Erik Larson, Clifford Gray: "Project Management: Rha Managerial Process": McGraw Hill Education: Sixth edition (1 July 2014)
9	Panneerselvam R: "Project Management": Prentice Hall India Learning Private Limited: 1st edition (2009).
Syllabus for Unit Test:	
Unit Test I : Units I, II, and III	
Unit Test II : Units IV, V, and VI	

B. Tech. – 2023 Course

Rules and Regulations

(I) Theory

(A) Theory Examination

Theory examination consists of: (i) End semester examination (ESE), and (ii) Internal assessment (IA).

(i) ESE is of 60 marks for theory courses.

(ii) IA is of 40 marks. Out of 40 marks, 20 marks will be for Unit Tests and 20 marks will be for Project Based Learning for a given course. Two Unit Tests, each of 20 marks, will be conducted. Average of marks obtained in these two unit tests will be considered as UT marks. Roll numbers allotted to the students shall be the examination numbers for the conduction of unit tests.

(B) Standard of Passing

(i) There is a separate passing of 40% of 60 marks, i.e. 24 marks, for ESE for a given course.

(ii) There is a separate passing of 40% of 40 marks, i.e. 16, for IA for a given course.

(iii) A student who fails at ESE in a given course has to reappear only at ESE as a backlog student and clear the head of passing. Similarly, a student who fails at IA in a given course has to reappear only at IA as a backlog student and clear the head of passing

(II) Practical

(A) Practical Examination

Practical examination consists of: (i) Term work, and (ii) Practical/Oral examination for a given course based on term work.

(i) Term work (TW): TW marks are as mentioned in the curriculum structure.

(ii) Practical/Oral (PR/OR): PR/OR marks are as mentioned in the curriculum structure.

(B) Conduction of practical/oral examination

(i) A student will be permitted to appear for practical/oral examination only if he/she submits term work of a given course.

(ii) Practical/oral examination shall be conducted in the presence of internal and external examiners appointed by university.

(C) Standard of Passing

(i) A student shall pass both heads TW and PR/OR separately with minimum 40% of total marks of respective head.

(III) MOOC and Social Activity Course

(i) If a student completes one MOOC during a programme, he/ she will earn additional TWO credits, subjected to submission of the certificate of completion of the respective course. It is mandatory for a student to complete atleast two MOOC to obtain degree in a given discipline. Students shall register to MOOCs which are offered by any one the following agencies:

(a) SWAYAM : www.swayam.gov.in
(b) NPTEL : www.onlinecourse.nptel.ac.in
(c) Course Era : www.coursera.org
(d) edX online learning : www.edx.org
(e) MIT Open Course ware : www.ocw.mit.edu
(f) Udemy : www.udemy.com
(g) Spoken tutorial : www.spoken-tutorial.org

(ii) If a student completes social activity, he/she will earn additional TWO credits, subjected to submission of the certificate of completion of the respective course/ activity from the relevant authorities. It is mandatory for a student to complete atleast one social activities to obtain degree in a given discipline.

(iii) The additional credits for MOOC and Social Activity will be given only after verification of the authentic document by the Head of the Department and a separate mark-sheet will be submitted by the Head of the Department along with the course examiner.

(IV) Value Added Course (VAC) and Indian Knowledge System (IKS) Course

(i) The VAC and IKS courses are mandatory and must be passed by students during the designated semester to earn two credits.

(ii) These courses have an internal assessment worth 100 marks, which are distributed as follows: (a) three assignments, each worth 20 marks, and (b) two case studies, presentations, or quizzes, each worth 20 marks. Faculty members have the flexibility to choose between conducting two case studies, two presentations, two quizzes, or any combination thereof.

(V) Minor Programme

(i) A students shall receive a MINOR degree when he/she acquires additional 20 credits in a given specialization defined by the UG programmes offered at the institute.

(ii) The theory and practical/oral components for a given course are mentioned in curriculum structure. The theory and examination for a given course are mentioned in Section I and II.

(iii) The grade point, grade letter and equivalent marks system for MINOR programme is mentioned in Section V.

(iv) The MINOR DEGREE programme is OPTIONAL. The interested students may opt MINOR

programme.

(v) A student shall complete the MINOR program prior to his/her graduation.

(VI) A. T. K. T

(i) A student who is granted term for B. Tech. Semester-I, III, V, VII will be allowed to keep term for his/her B. Tech. Semester-II, IV, VI, VIII examination, respectively even if he/she appears and fails or does not appear at B. Tech. Semester-I,III, V, VII examination respectively.

(ii) A student shall be allowed to keep term for the B. Tech. Semester-III course if he/she has a backlog of any number of Heads of passing at B. Tech. Semester-I & II taken together.

(iii) A student shall be allowed to keep term for the B. Tech. Semester-V of respective course if he/she has no backlog of B. Tech. Semester-I & II and he/she has a backlog of any number of Heads of passing at B. Tech. Semester-III & IV taken together.

(iv) A student shall be allowed to keep term for the B. Tech. Semester- VII of respective course if he/she has no backlog of B. Tech. Semester-I, II, III, IV and he/she has a backlog of any number of Heads of passing at B. Tech. Semester-V & VI taken together.

(VII) Grade Point, Grade Letter and Equivalent Marks

The student must obtain a minimum Grade Point of 5.0 (40% marks) in ESE and also in combined ESE + IA. A student who fails in ESE of a course has to reappear only to ESE as a backlog student and clear that head of passing.

Award of the Class for the Degree considering CGPA: A student who has completed the minimum credits specified for the programme shall be declared to be passed in the programme. The CGPA will be computed every year of all the courses of that year. The grade will be awarded according to the CGPA of every year.

Range of CGPA	**Final Grade**	**Performance Descriptor**	**Equivalent range of Marks (%)**
$9.50 \leq CGPA \leq 10.00$	O	Outstanding	$80 \leq Marks \leq 100$
$9.00 \leq CGPA \leq 9.49$	A+	Excellent	$70 < Marks < 80$
$8.00 \leq CGPA \leq 8.99$	A	Very Good	$60 < Marks < 70$
$7.00 \leq CGPA \leq 7.99$	B+	Good	$55 < Marks < 60$
$6.00 \leq CGPA \leq 6.99$	B	Average	$50 < Marks < 55$
$5.00 \leq CGPA \leq 5.99$	C	Satisfactory	$40 \leq Marks < 50$
CGPA below 5.00	F	Fail	Marks Below 40