

# **SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY**

(Deemed to be university U/S 3 of UGC Act 1956)

Accredited with Grade "A++" by NAAC | 12B Status by UGC | Approved by AICTE

Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119



## **MANDATORY AUDIT COURSES**

SBTB1101	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	EL	Credits	Total Marks
		1	0	0	3	0	100

**COURSE OBJECTIVE**

- To impart knowledge on the issues related to environment and to emphasize the importance of a clean environment

**UNIT 1 INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES**
**9 Hrs.**

Definition, scope and importance, need for public awareness, forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams, floods, drought, conflicts over water, dams-benefits and problems, mineral resources: use effects on forests and tribal people. water resources: use and over-utilization of surface and ground water, exploitation, environmental effects of extracting and using mineral resources, case studies food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources: Case studies. Land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification, role of an individual in conservation of natural resources, equitable use of resources for sustainable lifestyles.

**UNIT 2 ECOSYSTEMS AND BIODIVERSITY**
**9 Hrs.**

Concept of an ecosystem, structure and function of an ecosystem - producers, consumers and decomposers - energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Introduction to biodiversity, definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, biodiversity at global, national and local levels. India as a mega-diversity nation, hotspots of biodiversity, threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, endangered and endemic species of India, conservation of biodiversity, in-situ and ex-situ conservation of biodiversity.

**UNIT 3 ENVIRONMENTAL POLLUTION**
**9 Hrs.**

Definition - causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards. Solid waste management: causes, effects and control measures of urban and industrial wastes, role of an individual in prevention of pollution, pollution case studies, disaster management: floods, earthquake, cyclone and landslides.

**UNIT 4 SOCIAL ISSUES AND THE ENVIRONMENT**
**9 Hrs.**

From unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, watershed management, resettlement and rehabilitation of people; its problems and concerns, case studies, environmental ethics: issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. Wasteland reclamation, consumerism and waste products – environment protection act: air (prevention and control of pollution) act - water (prevention and control of pollution) act, wildlife protection act; forest conservation act. Issues involved in enforcement of environmental legislation, Key initiatives of Rio declaration, Vienna convention, Kyoto protocol, Johannesburg summit and public awareness.

**UNIT 5 HUMAN POPULATION AND THE ENVIRONMENT****9 Hrs.**

Population growth, variation among nations, population explosion, family welfare programme, environment and human health, human rights, value education, HIV / AIDS, women and child welfare, role of information technology in environment and human health, case studies. Visit to a local area to document environmental assets river/ forest / grassland / hill / mountain. Visit to a local polluted site-urban/rural/ industrial/agricultural-study of common plants, insects, birds-study of simple ecosystems, pond, river, hill slopes etc.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Recognize the need of conservation of natural resources for the future generations.
- CO2** - Differentiate the uniqueness of each and every ecosystem and biodiversity.
- CO3** - Identify the environmental pollution and to control them in a sustainable way.
- CO4** - Execute the possible solutions to manage the natural and manmade disasters for the sustainable living.
- CO5** - Distinguish the reasons for over population and give awareness to people through media to control population growth.
- CO6** - Solve the environment related problems by conserving the natural resources for the future generations.

**TEXT / REFERENCE BOOKS**

1. Meenakshi P., Elements of Environmental Science and Engineering, 1st Edition, Prentice Hall of India, New Delhi, 2009.
2. Ravikrishnan A., Environmental Science & Engineering, 3rd Edition, Sri Krishna Publications, Chennai, 2008.
3. Wrigh R.T. & Nebel B.J., Environmental science-towards a sustainable future by Richard, 8<sup>th</sup> Edition, Prentice Hall of India, New Delhi, 2006.
4. Erach Bharucha, Text Book of Environmental Studies, 2<sup>nd</sup> Edition, University Press, Chennai, 2006.

SISB4152	BASIC HEALTH AND HYGIENE FOR ENGINEERING	L	T	P	EL	Credits	Total Marks
		1	0	0	3	0	100

**COURSE OBJECTIVE**

- To understand the Basic principles, Scope & Rules of First Aid Managements
- Explain and apply principles of First Aid during emergencies

**UNIT 1 FIRST AID**

Explain and apply principles of First Aid during emergencies, Definition and Basic Principles - Scope & Rules of first aid.

**UNIT 2 FIRST AID MANAGEMENT**

Wounds, Hemorrhage & Shock - Musculoskeletal Injuries – Fractures, Dislocation, Muscle injuries.

**UNIT 3 RESPIRATORY EMERGENCIES**

Basic CPR procedure, Unconsciousness - Foreign Bodies – Skin, Eye, Ear, Nose, Throat & Stomach.

**UNIT 4 BURNS & SCALDS**

Procedures to handle burns and scalds, Poisoning, Bites & Stings.

**UNIT 5 FROSTBITE & EFFECTS OF HEAT**

Community Emergencies, treatment and procedures for frostbite and effects of heat.

**TEXT / REFERENCE BOOKS**

1. Brunner (V), Medical Surgical Nursing, LWW, 10th Edition.
2. Black, Medical Surgical Nursing: Clinical Management for positive outcomes, Elsevier, 7th edition.
3. Willams, Understanding Medical Surgical Nursing, Jaypee, 3rd edition.
4. Timby, Introductory Medical Surgical Nursing, LWW, 9th edition.
5. Lewis, Medical Surgical Nursing Assessment & Management of Clinical Problems, Elsevier, 7th edition.
6. Ignatavicius, Critical Thinking for Collaborative Care, Elsevier, 5th edition.
7. Monahan, Phipp's Medical Surgical Nursing: Health & illness perspectives practice, Jaypee, 8th edition.
8. AHA 2020 Guideline.

SISB4153	CONSTITUTIONAL LAW	L	T	P	EL	Credits	Total Marks
		1	0	0	3	0	100

**COURSE OBJECTIVE**

- To provide an understanding of basic concepts of the Indian Constitution and various organs created by the Constitution including their functions
- To know the significance of the Constitution of India and to give a deeper insight for making the nexus between the other subjects.
- To learn about the emergency provisions embedded in the Indian constitution.

**UNIT 1 INTRODUCTION****8 Hrs.**

Constitution – concept and definition – Constitutionalism- Indian Constitutional history – Constituent Assembly - Salient features – Federalism – quasi - federal nature - The Basic features Constitution of India - Preamble of the Constitution – Importance – Basic Structure - Important amendments- Implications of 42nd Amendment.

**UNIT 2 FUNDAMENTAL RIGHTS****10 Hrs.**

Concept of Fundamental Rights - Human Rights and Fundamental Rights - Interrelationship of Fundamental Rights- Right to equality: protective discrimination clause, reservation and social justice under Art.15 and 16 – Right to freedom: Freedom of speech and expression, - Right to life and personal liberty – scope and content – (expensive interpretation) – Policy and safeguards – Judicial review - Right against exploitation-Forced labour and child employment -Freedom of religion- Right to Constitutional Remedies – Judicial Review – Writs – Habeas Corpus, Mandamus, Certiorari, Prohibition and Quo-warranto – Art 32 and 226.

**UNIT 3 DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIES****9 Hrs.**

Nature of Directive Principles - social and welfare perspectives - Non-justiciability of Directive Principles- Constitutional amendments - to strengthen Directive Principles - Interrelationship between Directive Principles and Fundamental Rights. Fundamental Duties – Need for Fundamental duties – Enforcement Interrelationship with fundamental rights and directive principles. Amendment: Amendment-Art.368- Methods of Constitutional amendment- powers and procedure to amend the Constitution- Limitations upon constituent power- Doctrine of basic structure.

**UNIT 4 UNION AND STATE EXECUTIVE, LEGISLATURE AND CENTRE-STATE RELATIONS****9 Hrs.**

Westminster model - Choice of parliamentary government at the Centre and State. - Executive power – Separation of powers -President of India - Election, qualifications, salary and impeachment Powers- legislative, executive and discretionary powers. Council of Ministers Prime Minister – Cabinet system - Collective and Individual responsibility. Governor and state government - constitutional relationship. Lok Sabha, Rajya Sabha and State Legislative Assemblies - Practice of law-making. -Legislative privileges and fundamental rights - Coalition Government: Anti-defection Law Legislative relations - Administrative relations -Financial relations.

**UNIT 5 JUDICIARY AND EMERGENCY PROVISIONS****9 Hrs.**

Supreme Court of India (Articles 124-147) – Composition, Appointment, and Removal of Judges of Supreme Court - Independence of Judiciary – Tribunals High Courts – Composition- Appointment and Removal of Judges.

Emergency Provisions -Emergency- Meaning and scope - Proclamation of emergency - conditions - effect of emergency on center -state relations. - Emergency and suspension of fundamental rights

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Students should be able to possess the knowledge of Constitutional Law, Fundamental rights and fundamental duties.
- CO2** - Ability to understand and solve contemporary challenges.
- CO3** - To explore the basic principles of Constitutionalism, different models of federalism and its interplay in the Indian legal system.
- CO4** - Builds the ability to apply the knowledge gained from the course to current socio legal issues.
- CO5** - This course will equip the students with the required Professional Skills.

**TEXT / REFERENCE BOOKS**

1. M.P. Jain – Indian Constitutional Law Lexis Nexis, 8th Edition.
2. V.N. Shukla – Constitution of India, EBC, 2nd Edition.
3. D.D. Basu., Constitutional Law of India, Lexis Nexis, 24th Edition.
4. Dr. Narender Kumar., Constitutional law of India, Allahabad law Agency, New Edition.
5. Aditi Agarwal., Introduction to the Constitution of India, Asia Law House, 14th Edition.

SISB4154	HUMAN REALATIONS AT WORK	L	T	P	EL	Credits	Total Marks
		1	0	0	3	0	100

**COURSE OBJECTIVE**

- To analyze communication patterns and overcoming communication barriers.
- To explore motivation theories and practices to achieve organizational goals and objectives.
- To recognize and assess the role of interpersonal relations at work.
- To examine the various types of conflict and developing effective techniques for resolving conflict.
- To compare and contrast the major approaches to leadership and how leadership affects behavior, human relations, and job performance.

**UNIT 1 COMMUNICATION****9 Hrs.**

The communication process; Communication filters; Styles of communication, effect on interpersonal relations in organizations; Communication style bias; Style flexing; How to improve personal communication; informal and formal communication channels in the organization; Improving organizational communication; Cultural barriers.

**UNIT 2 IDENTIFYING MOTIVATIONS****9 Hrs.**

Nature of work motivation; Content and process theories of motivation Culture and self-identity; Theoretical views; Intrinsic vs extrinsic motivation; Use of positive reinforcement strategies. Understanding Individual Differences: Theories of personality; Impact of personality in workplace; perception, emotion and employee relations

**UNIT 3 INTERPERSONAL RELATIONS****9 Hrs.**

Work groups and work team; group dynamics; Need for affiliation; Group dynamics; Work teams and management theory; Work teams. Special Problems and Challenges in Workplace: Stress, coping with personal and professional life changes, resisting and adapting to change, stress management.

**UNIT 4 LEADERSHIP****9 Hrs.**

Approaches to Understanding Leadership, Behavioral theories, Contingency theories, charismatic leadership and transformational leadership; Ethics and trust; Mentoring; challenges to leadership; creating effective leaders

**UNIT 5 PERCEPTION AND INDIVIDUAL DECISION MAKING AND CONFLICT RESOLUTION****9 Hrs.**

Person perception; link between perception and individual decision making; decision making in Organizations; influences on decision making; ethics in decision making; Views on conflicts; The Conflict Process; Negotiation

**TEXT / REFERENCE BOOKS**

1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition), New York: McGraw Hill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.



SISB4155	YOGA	L	T	P	EL	Credits	Total Marks
		1	0	0	3	0	100

**COURSE OBJECTIVE**

- To educate, reflect upon, and understand the purpose of incorporating Yoga as a tool towards maintaining Health both physically and mentally.
- The purpose of this course is for helping students in incorporating yoga as a part of day-to-day activity for lifetime. This helps in regaining, maintain the physical and mental health of the students.

**UNIT 1 YOGA FOR WELLNESS****9 Hrs.**

Health meaning and definition – Concept of five layers of body (Pancha Koshas) – Yogic conception of health and diseases – Interdependency of physical and physiological (Prakriti & Triguna) components – Yogic Principles of healthy living (Theory)

**UNIT 2 PRINCIPLES AND PRACTICE OF YOGA****9 Hrs.**

Concept and meaning of Yoga - Foundations of yoga practice – Principles of Asana Practice – Careful construction of a yoga practice (Theory)

**UNIT 3 STANDING SEQUENCES****9 Hrs.**

Tādāsana, Pārśva Uttānāsana, Virabhadrasana, Trikonāsana, Utkatāsana, Ardha Utkatāsana, Ardha Uttānāsana, Uttānāsana, Suryanamaskar (Practical).

**UNIT 4 LYING TO SEATED SEQUENCES****9 Hrs.**

Śavāsana, Dvipāda pitham, Urdhva prsṛta pādāsana, Apānāsana, Sarvāṅgāsana with variations, bhujāṅgāsana, śalabāsana, Jānu śirsāsana, Pascimatānāsana, Vajrāsana forward bend to Cakravākāsana, Navāsana, Ardha Matsyendrāsana

**UNIT 5 PRĀṆĀYĀMA AND MEDITATIONS****9 Hrs.**

Prāṇāyāma : Single nostril breathing -Alternate nostril breathing – Brhmari Prāṇāyāma – Simple Meditation (Practical)

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understanding the importance of Loosing exercises before doing as postures.
- CO2** - Apply sun salutation practice in the daily practice for overall body health, activate and utilize the full potential of one's ownself.
- CO3** - Construct a daily practice schedule involving various postures that addresses the aim of the practice and promotes good health of the practitioner.
- CO4** - Apply the ideas of breath control and simple observation techniques in calming the mind.

**TEXT / REFERENCE BOOKS**

- 1 Desikachar, T. K. V. (1999). The Heart of Yoga: Developing a Personal Practice. United States: Inner Traditions/Bear.
- 2 Certification of Yoga Professionals an official guidebook level 1(2017); Excel books published limited, New Delhi. Saraswati, S. S. (2003). Asana Pranayama Mudra Bandha. India: Yoga Publications Trust.
- 4 Swami Vivekananda (2021), Meditation-And-Its-Methods. India: Prabhat Prakashan.
- 5 Yoga: Asanas-Pranayama-Mudras-Kriyas. (2002). Canada: Laurier Books, Limited.

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## **OPEN ELECTIVE COURSES**

SAEB4001	SATELLITE COMMUNICATION AND SATELLITE TECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- The course gives an exposure to the satellite navigation and control.
- To introduce students in engineering and the sciences to the methods of satellite radio navigation.
- The key physical principles will be described in terms of their application to make a complete navigation system work.

**UNIT 1 NAVIGATION CONCEPTS****9 Hrs.**

Fundamentals of spacecraft navigation systems and Position Fixing – Geometric concepts of Navigation – Elements - Earth in inertial space - Earth's Rotation - Revolution of Earth – Different Coordinate Systems – Coordinates Transformation - Euler angle formulations - Direction cosine formulation - Quaternion formulation.

**UNIT 2 CONTROL ACTUATORS****9 Hrs.**

Thrusters, Momentum Wheel, Control Moment Gyros, Reaction wheel, Magnetic Torquers, Reaction Jets, Ion Propulsion, Electric propulsion, solar sails.

**UNIT 3 INERTIAL NAVIGATION SYSTEMS****9 Hrs.**

Accelerometers – Pendulous type – Force Balance type – MEMs Accelerometers - Basic Principles of Inertial Navigation – Types - Platform and Strap down - Mechanization INS system – Rate Corrections - Block diagram – Acceleration errors – -Coriolis effect - Schuler Tuning – Cross coupling - Gimbal lock – Alignment.

**UNIT 4 GPS & HYBRID NAVIGATION SYSTEMS****9 Hrs.**

GPS overview – Concept – GPS Signal – Signal Structure- GPS data – Signal Processing – GPS Clock – GPS for position and velocity determination – DGPS Concepts - LAAS & WAAS Technology - Hybrid Navigation - Introduction to Kalman filtering – Case Studies -Integration of GPS and INS using Kalman Filter.

**UNIT 5 ATTITUDE STABILIZATION SCHEMES & ORBIT MANEUVERS****9 Hrs.**

Spin, Dual spin, Gravity gradient, Zero momentum system, Momentum Biased system, Reaction control system, Single and Multiple Impulse orbit Adjustment, Station Keeping and fuel Budgeting.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Utilize classical control theory, including analysis and design.
- CO2** - Apply concepts of aircraft autopilot design emphasizing the relevance of the topics discussed in the class.
- CO3** - Make use of modern control theory in various applications.
- CO4** - Apply radar theory.
- CO5** - Apply navigation principles and guidance laws.
- CO6** - Apply the schemes of orbital maneuver and stability of satellite.

**TEXT / REFERENCE BOOKS**

1. Albert D. Helfrick, "Modern Aviation Electronics", Second Ed., Prentice Hall Career & Technology, 1994.
2. James R Wertz, "Spacecraft Attitude Determination and control", Reidel Publications, 1978.
3. Kaplan, M. H., "Modern Spacecraft Dynamics and Control", Wiley India Pvt Ltd, 2011.
4. Marcel J. Sidi, "Spacecraft Dynamics and Control: A Practical Engineering Approach", Cambridge University Press, 2000.
5. Maxwell Noton, "Spacecraft navigation and guidance", Springer (London, New York), 1998.
6. Slater, J. M. Donnel, C.F.O and others, "Inertial Navigation Analysis and Design", McGraw-Hill Book Company, New York, 1964.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SAEB4002	DRONE DESIGN AND TECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To make the students to understand the basic concepts of UAV drone systems.
- To introduce the stability and control of an aircraft.

**UNIT 1 INTRODUCTION TO DRONES****9 Hrs.**

Introduction to Unmanned Aircraft Systems, History of UAV drones, classification of drones, System Composition, applications.

**UNIT 2 DESIGN OF UAV DRONE SYSTEMS****9 Hrs.**

UAV Design Principles: Introduction, Computational and Experimental Design of a Fixed-Wing UAV, Payload Design of Small UAVs, Small UAV Design Development and Sizing, Systematic Design Methodology and Construction of Micro Aerial Quadrotor Vehicles.

**UNIT 3 AVIONICS HARDWARE OF DRONES****9 Hrs.**

Autopilot, AGL-pressure sensors servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration

**UNIT 4 UAV MODELING, SIMULATION, ESTIMATION AND IDENTIFICATION****9 Hrs.**

UAV Modeling, Simulation, Estimation and Identification: Introduction, Flight Dynamics Modeling of Coaxial Rotorcraft UAVs, Modeling of a Micro UAV with Slung Payload, Command and Control of Autonomous Unmanned Vehicles

**UNIT 5: UAV INTEGRATION INTO THE NATIONAL AIRSPACE****9 Hrs.**

UAV Integration into the National Airspace: Introduction, Aviation Regulation, Human Factors of Unmanned Aircraft System Integration in the National Airspace System, Methodologies for Regulatory Compliance and Harmonization, Certification of Small UAS.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

**CO1** - Get the knowledge about Unmanned Aircraft Systems.

**CO2** - Ability to design UAV drone system.

**CO3** - Understand working of different types of engines and its area of applications.

**CO4** - Understand static and dynamic stability dynamic instability and control concepts.

**CO5** - Predict the loads taken by aircraft and type of construction and also construction materials in them.

**CO6** - Perform the Testing on waypoint navigation, ground control systems.

**TEXT / REFERENCE BOOKS**

1. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
3. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007.
4. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998.
5. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics.
6. Kimon P. Valavanis • George J. Vachtsevanos, "Handbook of Unmanned Aerial Vehicles", Springer, 2015.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SAEB4003	SPACE VEHICLE DESIGN AND SIMULATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To interpret the missile space stations, space vs earth environment.
- To explain the life support systems, mission logistics and planning.
- To deploy the skills effectively in the understanding of launch vehicle configuration design.

**UNIT 1 FUNDAMENTAL ASPECTS****9 Hrs.**

Energy and Efficiencies of power plants for launch vehicles – Typical Performance Values – Mission design – Structural design aspects during launch - role of launch environment on launch vehicle integrity.

**UNIT 2 SELECTION OF ROCKET PROPULSION SYSTEMS****9 Hrs.**

Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.

**UNIT 3 ENGINE SYSTEMS, CONTROLS, AND INTEGRATION****9 Hrs.**

Propellant Budget – Performance of Complete or Multiple Rocket Propulsion Systems – Engine Design – Engine Controls – Engine System Calibration – System Integration and Engine Optimization.

**UNIT 4 THRUST VECTOR CONTROL****9 Hrs.**

TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment.

**UNIT 5 NOSE CONE CONFIGURATION****9 Hrs.**

Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Know exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
- CO2** - Gain knowledge in selecting the appropriate rocket propulsion systems.
- CO3** - interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
- CO4** - Have an aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
- CO5** - Conversion training for aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.
- CO6** - Interpret nose cone configuration of launch vehicle.



**TEXT / REFERENCE BOOKS**

1. Michael D. Griffin, James R. French, "Space Vehicle Design", AIAA, 2nd Ed., 2004.
2. Karl Dawson Wood, "Aerospace Vehicle Design: Spacecraft Design", Johnson Publishing Company, 1964.
3. Bong Wie, "Space Vehicle Dynamics and Control", AIAA, 1998.
4. Anton H. de Ruiter, Christopher Damaren, James R. Forbes, "Spacecraft Dynamics and Control: An Introduction", John Wiley & Sons, 2012.
5. Marcel J. Sidi, "Spacecraft Dynamics and Control: A Practical Engineering Approach", Cambridge University Press, 2000.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SALB3071	INFORMATION TECHNOLOGY LAW	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To understand Cyber space and The Information Technology Act, 2000.
- To learn multifarious changes brought into substantive and procedural legislations.
- To know various facets of Cyber Law and its impact on modern world.

**UNIT 1 INTRODUCTION****9 Hrs.**

Concept of Information Technology and Cyber Space- Interface of Technology and Law -Jurisdiction in Cyber Space and Jurisdiction in Traditional Sense – Internet Jurisdiction – Indian Context of Jurisdiction – Enforcement Agencies- International Position of Internet Jurisdiction – Cases in Cyber Jurisdiction.

**UNIT 2 INFORMATION TECHNOLOGY ACT, 2000****9 Hrs.**

Aims and Objects — Overview of the Act – Jurisdiction-Electronic Governance – Legal Recognition of Electronic Records and Electronic Evidence -Digital Signature Certificates – Securing Electronic Records and Secure Digital Signatures – Duties of Subscribers – Role of Certifying Authorities – Regulators Under the Act-The Cyber Regulations Appellate Tribunal – Internet Service Providers and Their Liability – Powers of Police Under the Act – Impact of the Act on Other Laws.

**UNIT 3 E-COMMERCE NTEGRATION****9 Hrs.**

E-Commerce – UNCITRAL Model – Legal Aspects of E-Commerce – Digital Signatures – Technical and Legal Issues – E-Commerce, Trends and Prospects – E-taxation, E-Banking, Online Publishing and Online Credit Card Payment – Employment Contracts – Contractor Agreements, Sales, Re-Seller and Distributor Agreements, Nondisclosure Agreements- Shrink Wrap Contract-Source Code- Escrow Agreements etc.

**UNIT 4 CYBER LAW AND IPRS****9 Hrs.**

Understanding Copy Right in Information Technology – Software – Copyrights Vs. Patents Debate – Authorship and Assignment Issues – Copyright in Internet – Multimedia and Copyright Issues – Software Piracy –Patents – Understanding Patents – European Position on Computer Related Patents – Legal Position of U.S. on Computer Related Patents – Indian Position on Computer Related Patents –Trademarks – Trademarks in Internet – Domain Name Registration- Domain Name Disputes & WIPO-Databases in Information Technology – Protection of Databases – Position in USA,EU and India.

**UNIT 5 CYBER CRIMES****9 Hrs.**

Meaning of Cyber Crimes–Different Kinds of Cyber Crimes – Cyber Crimes Under IPC, Cr.P.C and Indian Evidence Law – Cyber Crimes Under the Information Technology Act, 2000 – Cyber Crimes Under International Law – Hacking- Child Pornography- Cyber Stalking- Denial of Service Attack- Virus Dissemination- Software Piracy- Internet Relay Chat (IRC) Crime- Credit Card Fraud- Net Extortion- Phishing etc. – Cyber Terrorism – Violation of Privacy on Internet – Data Protection and Privacy.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Have in-depth understanding of Information Technology Law.
- CO2** - Understand various Cyber Crimes.
- CO3** - Understand e-commerce.
- CO4** - Be acquainted with social and intellectual property issues in Cyberspace.
- CO5** - Be equipped with the regulations of the Information Technology law and various mechanisms working under the IT Act.
- CO6** - Equip Professional Skills.

**TEXT / REFERENCE BOOKS**

1. Anirudh Rastogi, Cyber Law: Law of Information Technology and Internet, Lexis Nexis Wadha, Nagpur, 1st ed., 2014.
2. Vakul Sharma, Information Technology Law and Practice, Universal Law Publishers, 3rd ed., 2011.
3. Harish Chander, Cyber Laws and IT Protection, PHI Learning Pvt. Ltd., 2012.
4. Nandan Kamath, Law Relating to Computers, Internet and Ecommerce, Universal Law Publishing Co., Ltd., 2006.
5. Pavan Duggal, Mobile Crime and Mobile Law, Saakshar Law Publications, 2013.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A : 10 Questions of 2 marks each-No choice**

**20 Marks**

**PART B : 2 Questions from each unit with internal choice, each carrying 16 marks**

**80 Marks**

SALB3083	INTELLECTUAL PROPERTY LAW	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To introduce the different categories of Intellectual Property Rights.
- To learn minimum standard to identify the items of protection.
- To know the rights conferred to the right holder and remedies available in the case of infringement.

**UNIT 1 INTRODUCTION****9 Hrs.**

Meaning and concept of intellectual Property and the need for protection – The world Intellectual property Organization (WIPO) Convention – Origin and functions of World Trade Organisation (WTO) – Trade Related Intellectual Property Rights (TRIPS) Agreement of WTO and its effects on Intellectual Property law in India; Dispute Settlement Mechanism.

**UNIT 2 COPYRIGHT ACT****9 Hrs.**

The Copyright Act (1957) and recent amendments-works in which copyright subsist-Authorship and Ownership- Different Rights-Registration of copyright-Term of copyright-Administration of copyright law- Performer's Rights-Broadcaster's Rights-Collective administration of copyrights-Moral Rights-Copyright Infringements-Remedies-Composition of Copyright Board.

**UNIT 3 TRADEMARK & DESIGNS ACT****9 Hrs.**

The Trade Mark Act (1999), object, definitions, salient features- Distinctiveness, deceptive similarity- Assignment and transmission -Registration: Procedure-Term-Effects-Grounds for refusal- Powers and functions of Registrar- collective marks-certification marks-Trade mark agents – Appellate board – Infringement action, passing off action –Well known marks- The designs Act 2000; definitions, registration of designs, copyright in registered designs, piracy of registered designs, remedies, powers and duties of Controller – Semi-conductor integrated circuit layout-Trade secrets.

**UNIT 4 LAW OF PATENTS****9 Hrs.**

The Patents Act (1970): Object definitions, salient features-Invention: patentable and non- patentable inventions- product and process patents- -Rights of patentees-assignment and transmission-term of patent-Registration-opposition to grant of patent, anticipation- Revocation of patents- Compulsory licences- Exclusive marketing rights-Infringement- exclusive marketing rights- Patent office and power of Controller, patents of addition-Patenting of biotechnology-Nanotechnology.

**UNIT 5 FARMERS AND BREEDERS RIGHT & GEOGRAPHICAL INDICATION 9 Hrs.**

The Protection of Plant Varieties and Farmers' Rights Act, 2001: object definitions, salient features The Geographical Indications of Goods (Registration and Protection) Act, 1999- object definitions, salient features.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Introduce fundamental aspects of Intellectual property Rights.
- CO2** - Understand aspects of the IPR Acts.
- CO3** - Apply basic principles of patents, trademarks, geographical designs, industrial designs, and copyright.
- CO4** - Understand international perspective and examines the international IP legal regime rather than focusing solely or predominantly on the national framework.
- CO5** - Analyse protection of plant varieties and farmers right act.
- CO6** - Learn Professional Skills.

**TEXT / REFERENCE BOOKS**

1. V.K. Ahuja, Law Relating to Intellectual Property Law, Lexis Nexis, 2nd ed., 2013.
2. N.S. Gopalakrishnan & T.G. Ajitha, Principles of Intellectual Property, Eastern Book Company, 2nd ed., 2014.
3. B.L. Wadhera, Law Relating to Intellectual Property, Universal Law Publishing, 5th ed., 2014.
4. S. Narayan, Intellectual Property Law in India, Gogia Law Agency, Hyderabad, 3rd ed., 2005.
5. Holyoak & Torremans, Intellectual Property Law, Oxford University Press, New York, 2010.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****Max.Marks:100****Exam Duration: 3 Hrs.**

Part A:10 Questions of 2marks each-No choice

**20 Marks**

Part B:2 Questions from each unit of internal choice, each carrying 16marks

**80 Marks**

SALB3073	INTERNATIONAL HUMAN RIGHTS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To introduce basic human rights philosophy, principles, instruments and institutions.
- To explore aspects of the diverse and increasingly complex body of international law of human rights that has both national and international application.
- To understand enforcement, implementation, remedies of International Human Rights Law.

**UNIT 1 HISTORICAL BACKGROUND****9 Hrs.**

Historical origins- state and self-determination-Ideological foundations- normative differences between "civil rights", "constitutional rights" and "human rights"-The charter and the declaration: universality, inalienability and right- balancing introduced in the 1948 Universal Declaration of Human Rights.

**UNIT 2 HUMAN RIGHTS NORMS****9 Hrs.**

International Bill of Rights- UN- The ICCPR (International Covenant on Civil and Political Rights) Framework Provisions-The Prohibition against Torture -Economic and Social Rights-Minority Rights- Universal Declaration of Human Rights (UDHR).

**UNIT 3 HUMAN RIGHTS INSTITUTIONS****9 Hrs.**

The Charter and Treaty Bodies- Regional Arrangements: emergence of regional arrangements for human rights – advantages and disadvantages of promoting human rights on a regional basis- Critical Perspectives: criticisms against the human rights movement- effectiveness and legitimacy and exposing its alleged biases.

**UNIT 4 PROTECTION OF HUMAN RIGHTS****9 Hrs.**

Human Rights, Peace, Non-Violence, and Conflict Resolution-Implementing Human Rights Standards and Required Legal Aid, Remedies and Reforms-Role of Judiciary- Role of National Human Rights Commission and State Legal aid -Public Interest Litigation and Media- Refugee right- rights of prisoners and prison reforms- rights of women and children- Role of other agencies- Rights of Children- Convention on Rights of Children- CEDAW.

**UNIT 5 IMPLEMENTATION, ENFORCEMENT, REMEDIES OF INTERNATIONAL HUMAN RIGHTS LAW****9 Hrs.**

Magna Carta- International enforcement of international law of human rights- International adjudication- International political implementation- International procedures for making human rights complaints within the UN system.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Identify main historical trends in the development of international human rights law.
- CO2** - Compare the international human rights law system and regional human rights law systems.
- CO3** - Evaluate the various mechanisms and procedures for human rights law enforcement.
- CO4** - Critically assess specific areas of international human rights law with reference to relevant legal instruments and contemporary cases.
- CO5** - Critically assess specific areas of international human rights law with reference to relevant legal instruments and contemporary cases.
- CO6** - This Course will equip the student with the required Professional Skills.

**TEXT / REFERENCE BOOKS**

1. Upendra Baxi, "The Future of Human Rights", Oxford University Press, New Delhi.
2. Daniel Moeckli, Sangeeta Shah and Sandesh Sikumaran "International Human Rights Law", 2014.
3. Alison Bisset, "Blackstone's International Human Rights Documents", 2014.
4. Asbjorn Eide, "International protection of human rights", Strasbourg, 1995.
5. Henry Steiner, Philip Alston, "International Human Rights in Context- Law, Politics and Morals", 2000.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SALB3096	PENOLOGY AND VICTIMOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To understand basic concepts in penology Victimology.
- To encourage critical thinking on crime victims' place in the justice system.
- To understand historical trends in punishment, in and outside the community context and to explore alternative approaches to victimization and punishment.

**UNIT 1 PENOLOGY& THEORIES OF PUNISHMENT****9 Hrs.**

Dimensions of Crime in India -Definition of penology-Theories of punishment-classical Hindu and Islamic approaches to punishment-Capital Punishment-Law reforms proposals- Criminal Justice System.

**UNIT 2 APPROACHES TO SENTENCING****9 Hrs.**

Alternatives to imprisonment-probation-corrective labour-fine: collective fines-reparation by the offender/ by the court- Parole: Nature- Authority for Granting Parole -The Probation of Offenders Act, 1958.

**UNIT 3 SENTENCING AND IMPRISONMENT****9 Hrs.**

Sentencing: Types of sentences: Indian penal code and special laws-white collar crimes-pre-sentence hearing: summary punishment-habitual offender-plea bargaining. Imprisonment: The prison system- Rights of prisoners –State of jails in India today-classification of prisoners-open prisoners- judicial surveillance, basis, development, reforms- Group Counseling and Re-Socialization Programme.

**UNIT 4 THE POLICE SYSTEM****9 Hrs.**

The Police System- Structural Organization of Police- Mode of Recruitment and Training- Powers and Duties of Police- Cr.P.C. and Other Laws- Constitutional Imperatives- Relationship between Police and Prosecution- Liability of Police for Custodial Violence- Police and Public Relations-Police force in India- the role of police- functions of police.

**UNIT 5 HUMAN RIGHTS****9 Hrs.**

Magna Carta- International enforcement of international law of human rights- International adjudication- International political implementation- International procedures for making human rights complaints within the UN system.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - familiarize with basic terms in Victimology and penology and describes historical developments in penology, with regards to the reasons for punishment.
- CO2** - Encourage critical thinking on crime victims place in the justice system.
- CO3** - Examines crime victims and patterns of punishment as complementary aspects of the criminal justice system, and explores their contributions to social perceptions of crime and justice.
- CO4** - Emphasize an idea of police system& prison system in India.
- CO5** - Revolve around Victimization and punishment as complimentary aspects of the criminal process, and their reciprocal effect on social perceptions.
- CO6** - equip the student with the required Professional Skills.



**TEXT / REFERENCE BOOKS**

1. Ahmed Siddique, Criminology: Problems and Perspective, Eastern Book Company, Lucknow, 2008.
2. N.Y. Paranjpe, Criminology and Penology, Central Law Publications, Allahabad, 2008.
3. Parkash Talwar, Victimology, Isha Books, Delhi, 2006.
4. Sumain Rai, Law Relating Plea Bargaining, Orient Publishing Company, 2007.
5. Dr. S.S. Srivastava, Criminology, Penology & Victimology, 4th ed, 2012, Repr.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SALB3084	LAND LAWS INCLUDING TENURE AND TENANCY SYSTEM	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To learn Movement of Land Reforms and abolition of Intermediaries.
- To understand the law for the acquisition of land required for public purposes.
- To know laws relating to land and land revenue in Tamil Nadu and Tamil Nadu Apartment Ownership Act, 1994.

**UNIT 1 INTRODUCTION: MOVEMENT OF LAW REFORMS 9 Hrs.**

Ownership of Land – Doctrine of Eminent Domain – Doctrine of Escheat – Pre-Independence Position- Land Tenure- Zamindari Settlement – Ryotwari Settlement - Mahalwari System – Intermediaries – Absentee Landlordism – Large Holdings- Post-independence Reforms: Abolition of Zamindari- Laws Relating to Abolition of Intermediaries.

**UNIT 2 LAND CEILING 9 Hrs.**

Urban Land Ceiling and Agrarian Land Ceiling- Tamil Nadu Land Reforms Fixation of Ceiling of Land Act 1961 and Amendment Act, 1971.

**UNIT 3 LAWS RELATING TO ACQUISITION OF PROPERTY GOVERNMENTAL CONTROL AND USE OF LAND 9 Hrs.**

Land Acquisition Act of 1894- Amendments to the Act – Tamil Nadu Amendments Act 1980 - Requisition and Acquisition of Immovable Property under Defense of India Act.

**UNIT 4 LAWS RELATING TO TENANCY REFORMS 9 Hrs.**

Rent Control and Protection Against Eviction- The Tamil Nadu Cultivating Tenants Protection 1955- The Tamil Nadu Cultivating Tenants (Payments of Fair Rent) Act, 1956- The Tamil Nadu Cultivating Tenants Arrears of Rent Relief Act, 1972- The Tamil Nadu Buildings (Lease and Rent Control) Act, 1960.

**UNIT 5 ENACTMENT AND CULTIVATING TENANTS 9 Hrs.**

The Tamil Nadu Cultivating Tenants Protection Act, 1955 – The Tamil Nadu Cultivating Tenants arrears of rent relief Act, 1972, 1980 – The Tamil Nadu Cultivating Tenants Protection from Eviction Act, 1983, 1989 – The Tamil Nadu Cultivating Tenants (payment of Fair Rent) Act, 1956 – The Tamil Nadu Agricultural Land Record of Tenancy Right Act, 1969– The Tamil Nadu Occupants of Kudiyruppu and Conferment of Ownership Act, 1971.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - This course will help the student to have an overview about Constitutional provisions relating to the concept of land.
- CO2** - It provides an outlook over tedious legislation prevailed regarding land and the reforms undertaken subsequently.
- CO3** - Will help the student in understanding the procedures of law relating to tenancy, ceiling and other related concepts.
- CO4** - Various reforms in this arena will enhance the research capacity of Student.
- CO5** - This course will enrich the student in approaching this legislation in a practical way.
- CO6** - This Course will equip the student with the required Professional Skills.

**TEXT / REFERENCE BOOKS**

1. Prof. A. Chandrasekaran, Land Laws of Tamil Nadu, 2nd Edn 2002, reprint 2010.
2. Kanwal Singh, Land Laws (Including Land Acquisition and Rent Laws), 1st Ed., 2014.
3. N.K. Acharya, Commentary on the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, Asia Law House, 2014.
4. Constitution of India- J.N.Pandey.
5. Dr. P PSexena, Transfer of Property Act, 2nd Ed. 2012.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SBMB4001	TELEHEALTH TECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	0	100

**COURSE OBJECTIVE**

- To enable the student to understand the scope and benefits of telemedicine using communication networks and their protocols.
- To learn about new healthcare needs through the applications of telemedicine.

**UNIT 1 INTRODUCTION****9 Hrs.**

Fundamentals of Telemedicine, Block diagram of Telemedicine, History of telemedicine: Main phases of Telemedicine, Tele-healthcare and E-medicine, Telemedicine access to health care services, Scope & Benefits and Limitation of Telemedicine. Social and legal issues, Safety and regulatory issues.

**UNIT 2 COMMUNICATION AND NETWORK****9 Hrs.**

Types of information: Audio, Video, Data, Fax, Still Image. Types of Communication and Networks: Overview of PSTN, POTS, ISDN, ATM, Videoconferencing, Wireless Communication – RF, GSM Satellite and Microwave, CDPD, Mobile handheld devices, and mobile communication. Internet technology and telemedicine using the world wide web (www)-Video and audio conferencing.

**UNIT 3 DATA EXCHANGE AND NETWORK SECURITY****9 Hrs.**

Basic concepts of the internet, Network Configuration, Circuit and Packet Switching, H.320 series, h.324 Protocols: TCP/IP, Standards for DICOM, Security: Encryption– DES, RSA, and cryptography.

**UNIT 4 ETHICAL AND LEGAL ASPECTS AND CASE STUDIES****9 Hrs.**

Confidentiality and law, Patient Rights and consent, Access to Medical Records, Consent treatment, jurisdictional issues, Intellectual Property Rights, Telemedicine technology and Health care delivery for rural population - Use of telemedicine technology for clinical diagnostic study-Conceptual framework on home telemedicine.

**UNIT 5 APPLICATIONS OF TELEMEDICINE****9 Hrs.**

Telemedicine – health education and self-care. Introduction to robotics surgery, Telesurgery. Teleradiography – Basic parts of a Teleradiography System, Telepathology, Telecardiology, Tele home – Care Home based Applications, Tele oncology, Telesurgery, Teledermatology, Telepharmacy.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understands the basics of telemedicine and its application in healthcare.
- CO2** - Classify the various standards and protocols related to telemedicine.
- CO3** - Discuss protocols and security for the transfer of telemedicine data.
- CO4** - Understand and apply the ethical and legal issues in telemedicine.
- CO5** - Explores the application of telehealth to modalities of medicine.
- CO6** - Compares the telehealth technologies for future challenges arising in our community.

**TEXT / REFERENCE BOOKS**

1. Olga, Ferrer–Roca, M. Sosa, Marcelo C, Handbook of Telemedicine, IOS press 2002.
2. Ling Guan, Multimedia image and video processing, CRCPress,2000.
3. Thorsten M Buzug, Heinz Handels, Dietrich Holz, Telemedicine: Medicine and communication, Springer-Verlag 2001.
4. Douglas V Goldstein, E Healthcare: Harness the power of internet, e–commerce, and e–care, Jones and Barlett Publishers.2000.
5. Norris A.C., Essentials of Telemedicine and Telecare, John Wiley & Sons, 2002.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SBMB4002	EMBEDDED SYSTEMS FOR BIOMEDICAL APPLICATIONS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- Basic Concepts of Embedded Systems.
- Various techniques are used for designing an embedded system.
- Real-time system with an example.

**UNIT 1                    SYSTEM DESIGN****9 Hrs.**

Embedded system, Processor embedded into a system, Embedded hardware units and devices in a system, Embedded software in a system, Embedded system architecture, Classifications, Skills required for an embedded system designer. Typical application scenario of embedded systems.

**UNIT 2                    EMBEDDED SYSTEMS DESIGN, DEVELOPMENT  
PROCESS AND TOOLS****9 Hrs.**

Complex systems and a microprocessor, Design process and metrics in embedded system, Design challenges, Optimizing the design metrics, Issues related to embedded software development, Hardware-software code sign, Embedded system design technology, Embedded software development process, and tools, Host and Target machine, Linking and Locating Software, Getting embedded software into the target system, Design process.

**UNIT 3                    REAL WORLD INTERFACING AND PROGRAMMING CONCEPTS                    9 Hrs.**

Study of microcontroller, Processor and memory organization, Switch, Keypad and LED interfacing, seven-segment display interfacing, Data Acquisition system, A/D, D/A converters, Programming in assembly language and high-level language, Embedded C programming- Simple programs, High-level language descriptions of software for embedded system.

**UNIT 4                    TECHNIQUES FOR EMBEDDED SYSTEMS****9 Hrs.**

State Machine and State Tables in embedded system design, Simulation, and Emulation of embedded systems. Real-time models, Language and Operating Systems-Tasks and task states, operating system services, RTOS functions, Interrupt routine in RTOS environment.

**UNIT 5                    BIOMEDICAL APPLICATIONS****9 Hrs.**

Body temperature measurement, Stepper motor control. Embedded system in biomedical application Wireless sensor technologies, Body sensor network, Patient monitoring system. Case study.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Discuss the basics of embedded systems and their hardware units.
- CO2** - Identify the various tools and development processes of embedded system.
- CO3** - Demonstrate the various I/O interfacing with the microcontroller.
- CO4** - Create the programming for embedded system design.
- CO5** - Summarize the real-time models, languages, and operating systems.
- CO6** - Design a real-time embedded system for biomedical applications.

**TEXT / REFERENCE BOOKS**

1. RajKamal, "Embedded Systems Architecture, Programming and Design", Tata McGraw-Hill, Second Edition, 2008.
2. Tim Wilhurst, "An Introduction to the Design of Small-Scale Embedded Systems, Palgrave, 2004.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SBMB4003	HUMAN FACTORS IN ENGINEERING AND DESIGN	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- Introduce the fundamental terms and concepts of human factors.
- Learn anthropometric principles and optimize human well-being and overall performance.

**UNIT 1 INTRODUCTION****9 Hrs.**

Introduction to human factors engineering - relevance of ergonomics. Process of seeing-visual capabilities-factors affecting visual acuity and contrast sensitivity -human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual displays and representational displays-process of hearing- principles of auditory displays.

**UNIT 2 MUSCLE PHYSIOLOGY****9 Hrs.**

Muscle physiology-muscle metabolism-respiratory response joint motion study-measure of physiological in-efficiency and energy consumption-work rest cycles-aspects of manual material handling (MMH). Bio-mechanical recommended limits of MMH.

**UNIT 3 CONTROLS AND COMPATIBILITY****9 Hrs.**

Spatial compatibility -physical arrangement of displays and controls- movement capability - rotary controls and rotor displays movement of displays-orientation of the operator and movement relationships-control orders and control responses human limitations in the tracking task.

**UNIT 4 ENVIRONMENTAL CONDITIONS AND HUMAN MACHINE INTERFACE****9 Hrs.**

Illumination, climate, noise, motion, sound, vibration, human system modeling, Human Output and Control, material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices.

**UNIT 5 ANTHROPOMETRY****9 Hrs.**

Anthropometry- anthropometric design principles-work space envelope factors in the design of workspace surfaces-principles of seat design-principles of control panel organization. Classification of human errors-dealing with human errors -theories of accident causes - reducing accidents by altering behavior.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Identify the problems in posture and work efficiency.
- CO2** - Classify the workspace and related systems.
- CO3** - Apply thoughts to design a human-computer interface.
- CO4** - Analyze the anthropometric concepts of the human system and environment.
- CO5** - Suggest practices to avoid errors & accidents in the workspace.
- CO6** - Create instrumentation techniques for the development of user-friendly systems.



**TEXT / REFERENCE BOOKS**

1. Mark S. Sanders & Ernest J. McCormick, Human Factors in Engineering and Design, Mc-Graw Hill International Edition, 2014.
2. Christopher D. Wickens, Introduction to Human Factors Engineering, Prentice Hall; 2nd edition, 2012.
3. Terence S. Andre, Aaron W. Schopper, Human Factors Engineering in System Design, British Columbia Teacher, 2013.
4. Wesley E. Woodson, Human Factors Design Handbook, McGraw-Hill Professional; 2nd edition, 2012.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SBMB4004	BIOMETRIC SYSTEM	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To comprehend the basic concepts of biometric modalities.
- To study the principles of biometric system design and its trade-offs.
- To introduce the knowledge on personal privacy and security implications of biometrics-based technology and its issues.

**UNIT 1 INTRODUCTION TO BIOMETRICS****9 Hrs.**

Introduction and background – biometric technologies – passive biometrics – active biometrics - Biometrics Vs traditional techniques – Benefits of biometrics - Operation of a biometric system– Key biometric processes: verification, identification and biometric matching-Performance measures in biometric systems - Assessing the privacy risks of biometrics.

**UNIT 2 PHYSIOLOGICAL BIOMETRICS CHARACTERISTICS****9 Hrs.**

Facial scan - Ear scan, Retina scan -Iris scan - Finger scan - automated fingerprint identification system - Palm print - Hand vascular geometry analysis - DNA - Dental.

**UNIT 3 BEHAVIORAL BIOMETRICS CHARACTERISTIC****9 Hrs.**

Signature scan - Keystroke scan - Voice scan, Gait recognition - Gesture recognition - Video face-mapping the body technology.

**UNIT 4 BIOMETRIC INTERFACES****9 Hrs.**

Human-machine interface - BHMI structure, Human side interface: Iris image interface - Hand geometry and fingerprint sensor - Machine side interface - Parallel port - Serial port - Network topologies.

**UNIT 5 BIOMETRIC APPLICATIONS****9 Hrs.**

Categorizing biometric applications, Application areas: Criminal and citizen identification – Surveillance - PC/network access - E-commerce and retail/ATM - Costs to deploy - Issues in deployment - Biometrics in medicine - cancellable biometrics.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the fundamentals of Biometrics and its processes.
- CO2** - Analyze the physiological biometric characteristics.
- CO3** - Evaluate the behavioral biometric characteristics.
- CO4** - Comprehend the interfaces used in the biometric systems.
- CO5** - Apply the concepts of biometrics in a real-world scenario.
- CO6** - Develop a basic biometric system for real-time applications.

**TEXT / REFERENCE BOOKS**

1. Anil K. Jain, Arun A. Ross & Karthik Nandakumar, "Introduction to Biometrics", Springer, 2011, ISBN 978-0-387-77326-1.
2. J.L. Wayman, A.K. Jain, D. Maltoni and D. Maio, "Biometric Systems: Technology, Design, and Performance Evaluation", Springer, 2005, ISBN 978-1-84624-064-1.
3. Samir Nanavati, Michael Thieme, Raj Nanavati, Biometrics: Identity Verification in a Networked World, John Wiley Publication, 2002.
4. G. R. Sinha, Biometrics: Concepts and Application, ISBN-13: 9788126538652, Wiley India Pvt Ltd.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SBMB4005	FORENSIC SCIENCE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To provide a brief and basic knowledge to understand forensic science, particularly to the biomedical student.
- To provide reasonable coverage of the subject to know the basic concepts of the sciences that the student can implement their knowledge in higher studies.
- To understand the forensic importance of chromosomal techniques.

**UNIT 1 FORENSIC SCIENCE AND EVIDENCE****9 Hrs.**

Definition of Forensic Science, The Role of the Forensic Laboratory, History and Development of Forensic Science in India & Abroad, Pioneers in Forensic Science, Concise of Forensic Physical, Biological, Chemical, and psychological evidence, Medico-Legal Cases, Branches of Forensic Science, Scope and jobs in Forensic Science.

**UNIT 2 BODY FLUIDS AND HUMAN REMAINS****9 Hrs.**

Blood and Body fluids—forensic significance— morphological identification of bones—forensic importance, Identification of Human remains—methods of reconstruction—personal identity in the living and the dead, Medico-legal aspects of death. Causes of death. Determination of time since death.

**UNIT 3 BIOMETRICS IN PERSONAL IDENTIFICATION****9 Hrs.**

Introduction, Concepts of Biometric Authentication, Role in person Identification, Techniques and Technologies - Finger Print Technology, Face Recognition, IRIS, Retina Geometry, Hand Geometry, Speaker Recognition, Signature Verification and gait patterns and their characteristics, DNA fingerprinting—RFLP, RAPD, PCR-Blotting types (Southern, Northern and Western)—forensic importance.

**UNIT 4 FORENSIC TOXICOLOGY****9 Hrs.**

Forensic toxicology – poison and drugs, classifications, Source, nature, Actions and diagnosis of poisoning cases, post-mortem findings and examination, treatment of poisoning cases, medicolegal aspects; corrosive agents, irritants, Applications of forensic toxicology.

**UNIT 5 SEROLOGICAL AND CHROMOSOMAL TECHNIQUES****9 Hrs.**

Serology—basic principles of serology – the concept of antigen and antibody and their reaction – application of serology in forensic science. Chromosomal theory of inheritance, Karyotyping—banding patterns—chromosomal abnormalities—sex determination—Barr bodies.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understands the basic knowledge about forensic importance and evidence.
- CO2** - Analyse the human body fluids and medico-legal aspects of death.
- CO3** - Recognize biometric authentication and molecular characterization of DNA for the identification of victims.
- CO4** - Demonstrate information about medico-legal aspects of different types of poisoning cases.
- CO5** - Remembers to identify unnatural causes of death based on immunological techniques.
- CO6** - Summarizes the karyotyping technique to identify a chromosomal abnormality.

**TEXT / REFERENCE BOOKS**

1. Nanda, B.B. and Tewari, R.K. (2001) Forensic Science in India: A vision for the twenty-first century Select Publisher, New Delhi.
2. James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques CRC Press.
3. Richard Saferstein Ed, Forensic Science Handbook, Prentice-Hall, 2010.
4. Narayan Reddy, The Essential of Forensic Medicine and Toxicology, 31<sup>st</sup> edition, 2012.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SBTB4001	BIOLOGY FOR ENGINEERS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To imply the importance of biology as a scientific discipline forming the basis for applying engineering knowledge.

**UNIT 1 EVOLUTION AND CLASSIFICATION****9 Hrs.**

Darwinian evolution & molecular perspective; Introduction to phylogeny - Classification systems in biology, Five kingdom classification, major groups and principles of classification in each kingdom. Systematic and binomial system of nomenclature.

**UNIT 2 GENETICS****9 Hrs.**

The cell concept, structure of prokaryotic, eukaryotic cells, plant cells and animal cells, Structure and function of cell membrane, cell organelles and their function. Tissues in animals and plants, Morphology, anatomy and functions. Concepts of alleles and genes, Mendelian Experiments, Cell cycle (Elementary Idea), mitosis and meiosis, techniques to study mitosis and meiosis.

**UNIT 3 BIOMOLECULES****9 Hrs.**

Biomolecules - classification, salient features - biological significance - carbohydrates, proteins and amino acids - lipids and fats - nucleic acids – vitamins - Enzymes.

**UNIT 4 BIOTECHNOLOGY****9 Hrs.**

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines-cloning-drug discovery-biological neural networks – bioremediation – biofertilizer – biocontrol biofilters – biosensors - biopolymers-biomaterials – biochips - basic biomedical instrumentation.

**UNIT 5 MICROBIOLOGY****9 Hrs.**

Brief history of microbiology, Types of microorganisms, Basic idea of domain bacteria, proteobacteria, non-proteobacteria Gram positive and Gram-negative bacteria, lichens, algae, protozoa, helminthes, viral structures, viral multiplication, Role of microorganisms in the production of industrial chemicals and pharmaceuticals.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Describe the major discoveries in biological sciences.
- CO2** - To understand the types and structures of different types of biomolecules in living systems.
- CO3** - Convey the classification of living beings and its structure and functions.
- CO4** - Analyze the processes of transcription and translation in both prokaryotes and eukaryotes at molecular level.
- CO5** - Understand the different classification of microorganism.
- CO6** - Explain the importance of microorganism in industry.

**TEXT / REFERENCE BOOKS**

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd.
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons.
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher.
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SBTB4002	ENTREPRENEURSHIP IN BIOTECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- Introduce students to the principles and concepts of bioentrepreneurship, and how it relates to the life sciences and biotechnology sectors.
- To develop students' understanding of the process of identifying and evaluating entrepreneurial opportunities in the bioindustry.

**UNIT 1 INTRODUCTION TO ENTREPRENEURSHIP****9 Hrs.**

Definition of Entrepreneurship and start up, Types of Entrepreneurships, Essential entrepreneurs' skills, Process of Entrepreneurship, Current status of start-up process registration in India, Start-up Agencies in India.

**UNIT 2 PRODUCTION OF MUSHROOM****9 Hrs.**

Definition of mushroom, classification, life cycle of Oyster mushroom, Type of Mushrooms: Oyster mushroom, Milky mushroom, Reishi. Mushroom production: Substrates, sterilization methods, Process, Value added products, scenario of mushroom cultivation in India.

**UNIT 3 PRODUCTION OF SERICULTURE AND API CULTURE****9 Hrs.**

Definition of Sericulture, Moriculture, silkworm life cycle and rearing, reeling. scenario of sericulture in India. Definition of Apiculture, Classification of Honey bee, life cycle, role of honey bee: Drone, Queen, Worker. Harvesting boxes, Extracting Products, apiculture biproducts, scenario of Apiculture in India.

**UNIT 4 PRODUCTION OF SPIRULINA AND VERMICOMPOSTING****9 Hrs.**

Definition of SCP, classification of Spirulina, Life cycle, Nutritional Profile and benefits, Production Process and Harvesting methods. Value added products, scenario of Spirulina cultivation in India. Definition of Vermicomposting, Substrates for vermicomposting, Production Process, applications. scenario of Vermicomposting in India.

**UNIT 5 PRODUCTION OF SEA WEEDS****9 Hrs.**

Classification of Seaweed, Life cycle, Benefits of seaweed, Production Process: Seed Material, methods of Farming, Harvesting Methods, value added products, scenario of Scenario of sea weed farming in India.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Describe the importance of Entrepreneurship.
- CO2** - Summarize the process of initiating start ups.
- CO3** - Demonstrate the cultivation of mushroom.
- CO4** - Analyse the effectiveness of Apiculture.
- CO5** - Appraise the process of Vermicompost technology.
- CO6** - Evaluate the value products of seaweeds.



**TEXT / REFERENCE BOOKS**

1. Biotech Consortium India Ltd, Resource book, 2018.
2. Suman B.C and Sharma V.P, Mushroom cultivation In India,2007.
3. Madhan Mohan Rao,M, An Introduction to Sericulture , 2nd Edition, BS Publications.2019.
4. Jayashree K.V, Thara Devi C.S, Arumugam N, Apiculture, SaraS Publications, 2014.
5. KarthiKeyan, Spirulina formula for starting harvest,2022.
6. Seetha Lekshmy, Santhi R, Vermitechnology, SaraS Publications, 2012.
7. Bruno Augusto Amato Borges, Seaweed Cultivation, Del Publishing, 2017.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SBTB4003	ORGANIC AGRICULTURE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To emphasize the need for novel organic methods in agriculture for healthy living and better soil management.

**UNIT 1 DEVELOPMENT OF ORGANIC AGRICULTURE 9 Hrs.**

Stages in Agricultural Development – History of Alternative Agricultural Development – Ill effects of Green Revolution Organic farming – Need, Concepts, Definition and Components – Essential characteristics – Key principles – Different concepts of organic farming – Natural farming, Biodynamic farming, Perma culture and Zero Budget Farming.

**UNIT 2 AGRICULTURAL POLLUTION AND MANAGEMENT 9 Hrs.**

Adverse effect of Modern Agriculture on soil and water resources - Impact of high technology agriculture on crop production – Soil pollution – Agro chemical pollution – Detrimental effects of currently chemical dependant farming - Reduction of crop production due to depletion of soil Health - Pesticide contamination and human health hazard - Contamination of food products by pesticides & chemicals - Environmental (soil, water, air) pollution - Reduction of natural enemies of crop pests - Threat to Bio diversity.

**UNIT 3 IMPORTANCE OF SOIL 9 Hrs.**

Soil formation, composition and characteristics, types of soil according to composition. Acidic, alkaline and saline soils – effect on agriculture and methods of reclamation. Soil productivity – meaning and concept. Difference between soil fertility and productivity, methods of increasing productivity and fertility. Properties of fertile soil.

**UNIT 4 ORGANIC SOURCES OF PLANT NUTRIENTS 9 Hrs.**

Essential plant nutrients, Soil plant nutrients, soil organic matter. Manures, farmyard manure, sheep and goat manure, poultry manure, concentrated organic manures. Compost, methods of composting, benefits of using composts to agriculture, improves the physical, chemical and biological properties of soil, vermicomposting, coir pith composting, crop residue composting, tricho-composting.

**UNIT 5 Biofertilizer 9 Hrs.**

Working principles of biofertilizer, application of biofertilizers. Green manuring, benefits of using green manuring, selecting green manures of use. Panchagavya, EM technology in organic farming.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Summarize the development of organic agriculture.
- CO2** - Associate the impact of current agricultural practices to pollution.
- CO3** - Interpret the impact of chemicals on soil fertility.
- CO4** - Analyze the characteristics of soil.
- CO5** - Appraise the effectiveness of manures and composts.
- CO6** - Recommend the application of biofertilizer and green manure.

**TEXT / REFERENCE BOOKS**

1. Principles of Organic Farming, E. Somasundaram, D. Udhaya Nandhini, M. Meyyappan, New India Publishing Agency, 2021.
2. Basics of Organic Farming, Bansal M, Athithi books, 2020.
3. Organic Farming Theory And Practice 2nd Revised Ed, Palaniappan S P and K Annadurai, Scientific Publishers (India), 2022.
4. Principles of Organic Farming, S.R. Reddy, Kalyani publications, 2017.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SBTB4004	ORNAMENTAL AQUACULTURE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To learn the basics of ornamental fish culture, Breeding, water quality and disease management.

**UNIT 1 INTRODUCTION TO ORNAMENTAL FISH CULTURE 9 Hrs.**

World trade of ornamental fish and export potential. Different varieties of exotic and indigenous fishes. Principles of a balanced aquarium. Fabrication, setting up and maintenance of freshwater and marine aquarium.

**UNIT 2 WATER QUALITY MANAGEMENT AND FILTRATION 9 Hrs.**

Water quality management. Water filtration system-biological, mechanical and chemical. Types of filters.

**UNIT 3 AQUARIUM PLANTS, ACCESSORIES AND FEEDS 9 Hrs.**

Aquarium plants and their propagation methods. Lighting and aeration. Aquarium accessories and decorative. Aquarium fish feeds. Dry, wet and live feeds.

**UNIT 4 ORNAMENTAL FISH CULTURE AND BREEDING 9 Hrs.**

Breeding and rearing of ornamental fishes. Brood stock management. Application of genetics and biotechnology for producing quality strains.

**UNIT 5 DISEASE MANAGEMENT AND TRADE 9 Hrs.**

Management practices of ornamental fish farms. Common diseases and their control. Conditioning, packing, transport and quarantine methods. Trade regulations and wild life act in relation to ornamental fishes.

**Max. 45 Hrs.****Course outcomes**

On completion of the course, student will be able to

- CO1** - Identify the common ornamental fishes and plants.
- CO2** - Design the aquarium tanks.
- CO3** - Setup the aquarium accessories and equipment.
- CO4** - Experiment the water quality parameters for aquatic organisms' culture and transport.
- CO5** - Formulate the feeds for aquatic organisms.
- CO6** - Investigate, Identify, and treat the ornamental fish diseases.

**TEXT / REFERENCE BOOKS**

1. Ahilan. B, Felix. N and Santhanam. R., 2008. Text book of Aquariculture. Daya Publishing House, New Delhi. p.157.
2. Ahilan. B, Felix. N and Jameson, J.D., 2009. Goldfish. Daya Publishing House, New Delhi. p.87.
3. Archana Sinha, Prem Shankar Pandey and Surya Kumar Prabhakar 2008. Training Manual on Culture and Breeding of Ornamental Fish. Central Institute of Fisheries Education, Kolkata centre.
4. Dey, V.K., 2008. Global Trade in Ornamental Fish: Trends, Prospects and Issues. Abstract, International seminar on Ornamental fish breeding, farming and trade, Cochin, India. pp.2.
5. Singh, T. and Dey, V.K., 2003. Ornamental fish trade runs into billions, Info fish Int., 5:54-60.
6. Thomas, K., 2008. Status of Ornamental fish trade in India with special reference to investment and trade opportunities. Abstract, International seminar on ornamental fish breeding, farming and trade, Cochin, India. pp.7.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCHB4001	ENERGY ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVE**

- To enable the learner to understand the various renewable energy sources, energy conversion, energy resources and fuel cells.

**UNIT 1 INTRODUCTION TO CONVENTIONAL & NON-CONVENTIONAL ENERGY SOURCES**
**9 Hrs.**

Conventional energy sources; non-conventional energy sources; Energy sources, Coal, Oil, Natural gas, nuclear fuels, Hydro power advantages. Classification of fuels. Introduction to solar energy, Solar radiation and its measurement, solar constant, solar radiation at earth's surface, solar radiation geometry, solar radiation measurement. Applications, solar water heating, space heating, space cooling, solar thermal electric conversion. Agriculture and industrial process heating, solar distillation, solar pumping, solar cooking.

**UNIT 2 ENERGY FROM BIOMASS (BIO – ENERGY): INTRODUCTION**
**9 Hrs.**

Biomass conversion Technologies. Wet processes, Dry processes. Biogas generation. Factors affecting bio digestion or generation of gas. Classification of biogas plants. Advantages and disadvantages of floating drum plant. Advantages and disadvantages of fixed dome type plant. Types of biogas plants (KVIC model & Janata model). Selection of site for biogas plant.

**UNIT 3 BIO – ENERGY (THERMAL CONVERSION) AND ELECTRICAL CONDUCTION (MHD)**
**9 Hrs.**

Methods of obtaining energy from biomass, Thermal gasification of biomass, Classification of biomass gasifiers, Chemistry of gasification process, Applications of the gasifiers. Magneto hydrodynamic generator, electrical conductivity and formation of MHD, performance comparison of open and closed cycle.

**UNIT 4 WIND ENERGY AND OTEC**
**9 Hrs.**

Basic components of WECS (wind energy conversion system): Classification of WECS, Types of wind machines, horizontal axis machines, vertical axis machines. Applications of wind energy. Energy from the oceans: Introduction, Ocean thermal electric conversion (OTEC), Methods of ocean thermal electric power generation, Open cycle OTEC system, Closed or Anderson OTEC cycle, hybrid cycle. Application of energy from oceans.

**UNIT 5 FUEL CELLS BASICS AND WASTE HEAT RECOVERY**
**9 Hrs.**

Fuel Cells, Difference between batteries and fuel cells, Components of fuel cells, Principle of working of fuel cells, Fuel cell types: Alkaline fuel cells. Polymer electrolyte fuel cells, Phosphoric acid fuel cells, Molten carbonate fuel cells, Solid oxide fuel cells, Applications. Co-generation- waste heat recovery and heat pump.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand various conventional and non- conventional energy sources.
- CO2** - Evaluate the advantages and disadvantages of various types of bio gas generators.
- CO3** - Demonstrate the working principle of biomass gasifiers.
- CO4** - Classify wind energy conversion systems.
- CO5** - Compare the various methods of generating ocean thermal electric power.
- CO6** - Demonstrate the working principle of various kinds of fuel cells.

**TEXT / REFERENCE BOOKS**

1. Rai G.D., Non-Conventional Energy Sources, 4<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2004.
2. Rao S.S., Energy Technology, 3<sup>rd</sup> Edition, Khanna Publishers, New Delhi, 2009.
3. R.K.Singal, Efficient utilization of energy, 2<sup>nd</sup> Edition, New Age International Publishers, New Delhi, 2017.
4. Christopher H. and Armsteed H., Geothermal Energy, 3<sup>rd</sup> Edition, John Wiley, New York, 2000.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCHB4002	INDUSTRIAL POLLUTION PREVENTION AND CLEANER PRODUCTION	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVE**

- Cleaner production is the continuous application of an integrated preventive environmental strategy applied to process, products and services to increase overall efficiency and reduce risks.
- To impart the knowledge on these principles are implied under the conception of cleaner production.

**UNIT 1 INTRODUCTION****9 Hrs.**

Industrial Activity and Environment – Industrialization and Sustainable Development – Indicators of Sustainability- Sustainability Strategies – Barriers to Sustainability – Industrial Ecology – Pollution Prevention (PP) and Cleaner Production (CP) in achieving Sustainability- Prevention versus Control of Industrial Pollution - Environmental Policies and Regulations to encourage Pollution Prevention and Cleaner Production – Regulatory versus Market-based approaches.

**UNIT 2 CONCEPT OF POLLUTION PREVENTION AND CLEANER PRODUCTION****9 Hrs.**

Definition – Importance - Historical Evolution – Benefits - Promotion - barriers – Role of Industry, Government and Institutions - Environmental Management Hierarchy – Source Reduction techniques – Process and Equipment Optimization, Reuse, Recover, Recycle, Raw material substitution - Internet information and Other PP and CP Resources

**UNIT 3 PP & CP MANAGEMENT****9 Hrs.**

Pollution Prevention and Cleaner Production Project development and implementation – Overview of CP Assessment steps and skills, Preparing the site, Information gathering, and Flow diagram, Material balance, PP and CP Option generation, Technical and Environmental Feasibility analysis, Total Cost analysis - PP and CP Financing

**UNIT 4 MANAGEMENT PROGRAM****9 Hrs.**

Establishing a Program - Organizing a Program- Preparing a program plan - Measuring progress – Pollution Prevention and Cleaner Production Awareness Plan - Waste Audit- Environmental Statement - Environmental Management Program – Economic incentive and disincentives as instruments for environmental management – Tax, subsidies, fee, tradable permits.

**UNIT 5 CASE STUDIES****9 Hrs.**

Industrial Applications of PP and CP, LCA, EMS and Environmental Audits.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand Industrialization, Sustainable Development and Environmental Policies and Regulations.
- CO2** - Apply concept of pollution prevention and role of industry.
- CO3** - Estimate Source Reduction techniques and apply cleaner production.
- CO4** - Analyze Pollution Prevention management.
- CO5** - Analyze Cleaner Production and cost analysis.
- CO6** - Carry out material balance and various audits.



**TEXT / REFERENCE BOOKS**

1. Paul L. Bishop, "Pollution Prevention: Fundamentals and Practice", McGraw-Hill International, 2016.
2. World Bank Group, "Pollution Prevention and Abatement Handbook-Towards Cleaner Production", World Bank and UNE, Washington D.C., 1998.
3. Prasad Modak, C. Visvanathan and Mandar Parasnis, "Cleaner Production Audit Environmental System Reviews", No. 38, Asian Institute of Technology; Bangkok, 1995.
4. Freeman, H.M, Industrial Pollution Prevention Handbook", McGraw Hill", 2005.
5. James G. Mann and V.A. Liu, "Industrial Water Reuse and Wastewater Minimization", McGraw Hill, 2018.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCHB4003	AIR POLLUTION AND CONTROL ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVE**

- To confer information on the guideline and plan of control of Indoor/particulate/vaporous air contamination and its arising patterns.
- To give general comprehension of nature of air and effect on neighborhood and worldwide impacts of air contamination on human, materials, properties and vegetation.
- To concentrate on the destiny and transport of air contaminations and its estimation strategies.
- To confer the information and comprehension of circumstances and end results of air contamination and their controlling instruments.

**UNIT 1 INTRODUCTION****9 Hrs.**

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards.

**UNIT 2 METEOROLOGY****9 Hrs.**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

**UNIT 3 PARTICULATE CONTAMINANTS****9 Hrs.**

Control of Particulate Contaminants: Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle - Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators.

**UNIT 4 GASEOUS CONTAMINANTS****9 Hrs.**

Control of Gaseous Contaminants: Factors affecting Selection of Control Equipment – Working principle - absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

**UNIT 5 AIR QUALITY MANAGEMENT****9 Hrs.**

Indoor Air Quality Management: Sources, types and control of indoor air pollutants, sick building syndrome and building related illness. Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Identify the sources of air pollutants in a city.
- CO2** - Estimate the damage due to air pollutants.
- CO3** - Associate air pollution with meteorology.
- CO4** - Calculate the concentrations of various air pollutants.
- CO5** - Predict the concentrations of various air pollutants.
- CO6** - Design air pollution control framework.

**TEXT / REFERENCE BOOKS**

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science + science media LLC, 2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press, Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.
4. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
5. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
6. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCHB4004	INDUSTRIAL WASTEWATER TREATMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVE**

- To understand various terms used in industrial wastewater treatment and to acquaint with different steps involved in treatment of industrial wastewater.

**UNIT 1 WATER POLLUTION****9 Hrs.**

Nature and types of water pollutants, organic and inorganic water pollutants - Water treatment- municipal sewage and industrial water treatment, Preliminary primary, secondary and tertiary treatment methods water reuse and recycling. General Characteristics of Industrial Effluents, Effects on Environment - ISI tolerance limits for discharging industrial effluents into surface water, into public sewers and onto land for irrigation - Toxic chemicals from industry.

**UNIT 2 INDUSTRIAL WASTEWATER MANAGEMENT****9 Hrs.**

Basic theories, Industrial waste survey -Measurement of industrial wastewater Flow-generation rates – Industrial wastewater sampling and preservation of samples for analysis -Wastewater Characterization-Toxicity of industrial effluents.

**UNIT 3 TREATMENT OF WASTEWATER****9 Hrs.**

Unit operations and processes-Volume and Strength reduction –Neutralization and Equalization, Segregation and proportioning-recycling, reuse and resources recovery.

**UNIT 4 INDUSTRIAL EFFLUENTS TREATMENT****9 Hrs.**

Pretreatment of Industrial effluents - Necessity of pretreatment - Equalization - Segregation - Process Changes Salvaging - By product Recovery. Removal by Reverse Osmosis, Ion Exchange, Electrodialysis, Solvent Extraction, Floatation. Removal of Refractory Organics - Removal of Nitrogen and Phosphorus.

**UNIT 5 COMMON EFFLUENT TREATMENT PLANTS (CETP)****9 Hrs.**

Location, Design, Operation and Maintenance Problems – Economical aspects. Major Industrial Effluents: Sources, Characteristics and Treatment. Food Industries: Sugar, Dairy, Distilleries, Chemical Industries: Paper and Pulp, Tanneries, Textiles, Fertilizers, Pharmaceuticals, Cement and Steel industry.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Analyze the characteristics of waste water.
- CO2** - Examine the manufacturing process of various industries.
- CO3** - Design treatment methods for any industrial wastewater.
- CO4** - Develop a component, system or process or technology to meet desired needs and imposed constraints.
- CO5** - Ability to analyze the data, interpret results and draw conclusions.
- CO6** - Assess need for common effluent treatment plant for an industry.

**TEXT / REFERENCE BOOKS**

1. M. N. Rao and A. K. Dutta, "Wastewater Treatment", Oxford & IBH, New Delhi.
2. K.V. S. G. Murali Krishna, "Industrial Water and Wastewater Management".
3. A. D. Patwardhan, "Industrial Wastewater treatment", PHI Learning, Delhi.
4. Metcalf and Eddy Inc., "Wastewater Engineering", Tata McGraw Hill co., New Delhi.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCHB4005	PROCESS SAFETY MANAGEMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVE**

- To enable the students to understand the importance of safety in process industries.
- To assess and identify the potential hazards in process industries.

**UNIT 1 INTRODUCTION****9 Hrs.**

Need for safety in industries, Safety Programmes, components and realization; Potential hazards, extreme operating conditions, toxic chemicals, safe handling.

**UNIT 2 SAFETY PROCEDURES****9 Hrs.**

Implementation of safety procedures, periodic inspection and replacement, Accidents, identification and prevention, promotion of industrial safety.

**UNIT 3 RISK ANALYSIS****9 Hrs.**

Overall risk analysis, emergency planning-on site & off-site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment - rapid and comprehensive risk analysis, Risk due to radiation, explosion due to over pressure, jet fire-fire ball.

**UNIT 4 HAZARD ANALYSIS****9 Hrs.**

Hazard identification safety audits, checklist, vulnerability models event tree analysis, fault tree analysis, Hazan past accident analysis Flixborough-Mexico-Madras-Vizag-Bhopal analysis.

**UNIT 5 SAFE MANAGEMENT IN INDUSTRIES****9 Hrs.**

Safe Handling and Operation of materials and Machinery, periodic inspection and replacement, maintenance of pumping system-reactor-mass transfer system.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Assess the risk in a process plant by hazard identification.
- CO2** - Determine the impact of the consequences of accidents and incidents.
- CO3** - Analyze a safety audit in a process plant with case studies.
- CO4** - Demonstrate the awareness of plant safety in selection and layout of chemical plants and the usage of safety codes.
- CO5** - Exhibit the skill in classifying chemical, fire, explosion hazards and to understand the occupational diseases.
- CO6** - Analyse and implement the engineering response to health hazards.

**TEXT / REFERENCE BOOKS**

1. Daniel A.Crowl, Joseph F. Louvar., Chemical Process Safety Fundamentals with Applications, 3<sup>rd</sup> Edition, Prentice Hall Inc., New Jersey, 2011.
2. Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004.
3. Ericson C.A., Hazard Analysis Techniques for System Safety, 2<sup>nd</sup> ed., Wiley, USA, 2015.
4. Fawcett H.H. and Wood W.S., Safety and Accident Prevention in Chemical Operation, 2<sup>nd</sup> Edition, Inter Science, 1982.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****Max.Marks:100****Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each–No choice

**20 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 16 marks

**80 Marks**

SCHB4006	SUSTAINABLE ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVE**

- To establish clear understanding and the role on the various impacts and issues related to sustainability.

**UNIT 1 SUSTAINABILITY****9 Hrs.**

Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

**UNIT 2 WASTE MANAGEMENT****9 Hrs.**

Zerowaste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon footprint, legal provisions for environmental protection.

**UNIT 3 STANDARD****9 Hrs.**

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

**UNIT 4 RESOURCES AND ITS UTILIZATION****9 Hrs.**

Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

**UNIT 5 SUSTAINABILITY PRACTICES****9 Hrs.**

Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the relevance and the concept of sustainability and the global initiatives.
- CO2** - Explain the different types of environmental pollution problems and their sustainable solutions.
- CO3** - Discuss the environmental regulations and standards.
- CO4** - Demonstrate the broad perspective of sustainable practices.
- CO5** - Analyze the problem and to develop the solutions in the area of sustainability for research and education.
- CO6** - Ability to quantify resource availability and rationalize the sustainability based on scientific merits.



**TEXT / REFERENCE BOOKS**

1. W. Wimmer, and Joanne Kauffman (Eds.), Handbook of Sustainable EngineeringSpringer (Available in June2011).
2. Daniel A. Vallero and Chris Brasier. Wiley-Blackwell (2008).Sustainable Design: The Science of Sustainability and Green Engineering Sustainable Engineering Practice: An Introduction.
3. Committee on Sustainability, American Society of Civil Engineers (2004).
4. Systems Analysis for Sustainable Engineering: Theory and ApplicationsNi-Bing Chang, McGraw-Hill (2010).

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCHB4007	CORROSION ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

**COURSE OBJECTIVE**

- To provide fundamental understanding of aspects of electrochemistry and material science relevant to corrosion phenomena, prevention and remediation of corrosion.

**UNIT 1 INTRODUCTION****9 Hrs.**

Definition of Corrosion, corrosion damage, effect of material safety and reliability, classification of corrosion, expression of corrosion rate, electrochemical corrosion reaction, redox reaction, effect of oxygen, oxidizers. Effect of temperatures, concentration of chemicals on corrosion rate, Corrosion: direct & two stage attack, electrochemical attack.

**UNIT 2 TYPES OF CORROSION****9 Hrs.**

Effect of galvanic coupling, metallurgical aspects, metallic properties, ringworm corrosion, Principle of modern corrosion theory, Forms of corrosion, Uniform attack, galvanic corrosion, crevice corrosion, pitting inter-granular corrosion and hydrogen damage, higher corrosion resistance through proper selection of material. Technologies of anodization, enamelling, rubber lining, glass lining, refractory lining, painting and other surface protective measures. Pourbaix Diagram for Iron, Magnesium and Aluminum.

**UNIT 3 APPLICATION OF CORROSION ENGINEERING****9 Hrs.**

Corrosion engineering in special applications such as material transport, pumping, filtration, condensation, boiling, riveting, welding, and high temperature environments. Surfacing Processes – CVD And PVD Processes, Sputter Coating. Laser and Ion Implantation, Arc Spray, Plasma Spray, Flame Spray, HVOF.

**UNIT 4 CORROSION TESTING AND MEASUREMENTS****9 Hrs.**

Corrosion testing, monitoring and inspection, laboratory corrosion test, accelerated chemical tests for studying different forms of corrosion, electrochemical methods of corrosion rate measurements by DC and AC methods, corrosion monitoring methods, chemical and electrochemical removal of corrosion products, cost factor in competitive corrosion prevention and inhibition techniques.

**UNIT 5 INDUSTRIAL CASE STUDIES****9 Hrs.**

Corrosion by organic acids and alkalise. Seawater and Fresh water corrosion on concrete structures, Corrosion in automobiles, biological corrosion, Halogen corrosion of metals, Corrosion in Petroleum industry, Corrosion in aerospace. Corrosion and selection of materials of pulp and paper plants. Corrosion of wet scrubbers in pollution control. Nuclear waste isolation and corrosion by liquid metal and fused salts. Corrosion of surgical implants and prosthetic devices. Corrosion in electronic equipment.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Equipped with in an introduction to corrosion and its mechanism/types.
- CO2** - Enable to explain the different types of corrosion.
- CO3** - Inculcate the protective measures to overcome corrosion.
- CO4** - Development of advanced technological process for corrosion prevention.
- CO5** - Measurement and monitoring of corrosion mechanism.
- CO6** - Attribute in depth knowledge to solve industrial corrosion situations.

**TEXT / REFERENCE BOOKS**

1. Uhlig. H.H. "Corrosion and Corrosion Control". 2nd Edition, John Wiley & Sons. New York. USA. 2002.
2. Butler, G., H.C.K., Corrosion & its Prevention in Waters, 5th Edition, Leonard Hill, London, 2010.
3. Maslow, P., Chemical Materials for Construction, 3rd Edition, Structures Publishing Co., 2001.
4. Fontance, M.G. & Gtretrnee, N.D., Corrosion Engineering, 4th Edition, McGraw Hill, 2006.
5. Rajagopalan, K.S. Corrosion and its Prevention, Chemical Engineering Education Development Centre, IIT Madras, 2005.
6. Fontana M.G., "Corrosion Engineering", 3rd Edition, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2005.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCIB4001	DISASTER MANAGEMENT	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To create an awareness towards natural and man-made disasters, disaster preparedness and disaster management.
- To prevent disasters and achieve substantial reduction of disaster risk and losses in lives, livelihoods, health, and assets.
- To study the risk assessment and people participation in risk assessment for holistic approach.

**UNIT 1 INTRODUCTION TO DISASTERS****9 Hrs.**

Natural resources and its importance - understanding on fragile eco-system - characteristics and types of Disasters, Geological and Mountain Area Disasters: Earthquakes, Volcanic eruption, landslides - Wind and Water Related Natural Disaster: Floods, Droughts, Cyclones, Tsunamis - Man Made Disasters: Forest fires, Nuclear, Biological and Chemical disaster - Causes and effects - Disaster Profile of India - Disaster Management cycle.

**UNIT 2 DISASTER PREPAREDNESS****9 Hrs.**

Disaster management, mitigation and preparedness: Disaster Preparedness for People and Infrastructure, Community based Disaster Preparedness Plan - Roles & Responsibilities of Different Agencies and Government: Education, Communication & Training, Central, State, District and local administration, Armed Forces, Police, Para Military Forces, International Agencies, and NGO's - Disaster Mitigation: Strategies, Emerging Trends, Mitigation management and Role of Team and Coordination.

**UNIT 3 REHABILITATION, RECONSTRUCTION AND RECOVERY****9 Hrs.**

Damage assessment – Development of Physical and Economic Infrastructure - Nature of Damage to Houses and Infrastructure due to Disasters - Funding Arrangements for Reconstruction - Monitoring and Evaluation of Rehabilitation Work: Training, Rescue and planning the rescue activities and rehabilitations - Role of Government and NGO's - Participative Rehabilitation Process: Case Studies.

**UNIT 4 DISASTER RESPONSE AND DISASTER MANAGEMENT****9 Hrs.**

Disaster Response Plan: Communication, Participation and Activation of Emergency Preparedness Plans, Search, Rescue, Evacuation and other logistic management - Human Behaviour and Response Management: Psychological Response and Psychological Rehabilitation, Trauma and Stress Management, rumour and Panic Management, Medical and Health Response to Different Disasters - Relief Measures: Minimum Standard of Relief, essential components of Relief Management, and funding.

**UNIT 5 RISK ASSESSMENT AND VULNERABILITY ANALYSIS****9 Hrs.**

Hazard, Risk and Vulnerability: Concept and Relationship: Disaster Risk Reduction, People Participation in Risk Assessment - Vulnerability Analysis, Vulnerability Identification - Vulnerability profile of India - Strategies for Survival - Social Infrastructure for Vulnerability Reduction.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the fragile ecosystem and the types of the disasters.
- CO2** - Examine the preparedness and the responsibilities of different agencies on Disaster.
- CO3** - Implement the rescue, rehabilitation and reconstruction process of disaster management.
- CO4** - Assess the disaster response and relief measures.
- CO5** - Understand the concepts of disaster risk.
- CO6** - Gain and insight of the concepts of vulnerability reduction.

**TEXT / REFERENCE BOOKS**

1. Bryant Edwards, "Natural Hazards", Cambridge University Press, U.K, 2005.
2. Carter, W. Nick, "Disaster Management, Asian Development Bank", Manila, 1991.
3. Government of India, "Vulnerability Atlas of India", New Delhi, 1997.
4. Sahni, Pardeep et.al. (eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2002.
5. Sahni, Pardeep and Ariyabandu, "Disaster risk reduction in South Asia", Phi learning pvt. Ltd., New Delhi, 2012.
6. Sharma, R.K. & Sharma, G.,(ed), "Natural Disaster", APH Publishing Corporation, New Delhi, 2005.
7. Taori, K, "Disaster Management through Panchayati Raj", Concept Publishing Company, New Delhi, 2005.
8. NOAA Coastal Services Center, "Linking People Information and Technology".

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A** : 10 Questions of 2 marks each-No choice

**20 Marks**

**PART B** : 2 Questions from each unit with internal choice, each carrying 16 marks

**80 Marks**

SCIB4002	PUBLIC HEALTH ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To provide knowledge about the solid waste management and its disposal.
- To implicate the importance of wastewater treatment.
- To create awareness and importance of the Rainwater Harvesting and Artificial Recharge Techniques.
- To provide an awareness about the health impacts due to water, air and land pollution.
- To gain knowledge on various regulatory bodies and acts.

**UNIT 1 SOLID WASTE MANAGEMENT****9 Hrs.**

Importance of public health engineering – Role of public health engineer - Sources and types of solid wastes - Waste generation rates and variation - Components of Integrated SWM - Sustainable SWM techniques at source - Segregation and sorting, reduce, reuse, and recycle. Present scenario of SWM in Urban Local Bodies - Dumping of solid waste- sanitary landfills- waste disposal options - Case studies related to reuse of waste.

**UNIT 2 WASTEWATER MANAGEMENT****9 Hrs.**

Sewage – classification - Waste water treatment – primary, secondary and tertiary stages - Standards for Disposal – Methods - Self- purification of river- Oxygen sag curve - Land disposal – Sewage farming - Objectives – Sludge characterization – Thickening – Design of gravity thickener- Sludge digestion – Sludge Conditioning and Dewatering – Sludge drying beds- ultimate residue disposal – recent advances - Case studies related to wastewater reclamation.

**UNIT 3 WATER QUALITY MANAGEMENT****9 Hrs.**

Role of Environmental Engineer - Water supply - development of public water supply - need for protected water supplies - objectives of water supply systems — Quality of water - physical, chemical and biological aspects - analysis of water - water quality standards - Sustainable Development - Rainwater Harvesting-Artificial Recharge Techniques – Case studies related to water management.

**UNIT 4 HEALTH IMPACTS****9 Hrs.**

Health and environmental effects of water, air and land pollution - Chemicals in drinking water - Sources of air pollution – Sources of land pollutants - Disease - Preventive measures – Case studies related to pollution effects.

**UNIT 5 GUIDELINES FOR WATER ACT & AIR ACT****9 Hrs.**

Industrial Applications of PP and CP, LCA, EMS and Environmental Audits.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the segregation and 3R from the solid waste.
- CO2** - Perform basic design of the unit operations and processes that are used in sewage treatment.
- CO3** - Analysis of water quality criteria and standards and their relation to public health.
- CO4** - Study on health impacts and its preventive measures.
- CO5** - Gain and insight about the various boards for water and air acts.
- CO6** - Understand the prevention and control of water and air pollution acts.

**TEXT / REFERENCE BOOKS**

1. Khan, I. H., & Ahsan, N. (2019). Textbook of solid waste management. New Delhi: Satish Kumar Jain for CBS Publisher and Distributors.
2. Mantell C.L., (1975), "Solid Waste Management", John Wiley.
3. "Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2012), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Viessman Jr, Hammer J. M, Perez, E.M, and Chadik, P. A, Water Supply and Pollution Control, PHI Learning, New Delhi, 2009.
5. CPHEEO (2016). Manual on Municipal Solid Waste Management, Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development, Govt. of India, New Delhi.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCSB4001	5G NETWORKS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To gain in depth knowledge of wireless networks for the future communication systems.
- To study the concepts of wireless networks for the future communication systems.
- To discuss 5G networks and its applications.

**UNIT 1 MULTI-GIGABIT WIRELESS NETWORKS****9 Hrs.**

Next generation (5G) wireless technologies- Upper Gigahertz and Terahertz wireless communications: Millimeter wave networking - Directionality and beam forming- Mobility and signal blockage - IEEE 802.11ad (60 GHz WLAN) MAC and PHY overview: Visible light communication- High-speed networking using LEDs - IEEE 802.15.7 PHY and MAC overview Sensing through visible light- Visible light indoor localization and positioning.

**UNIT 2 INDOOR LOCALIZATION AND RF SENSING****9 Hrs.**

Smartphone localization - WiFi fingerprinting - protocols and challenges - non-WiFi localization - Device-free sensing with radio frequency - Mining wireless PHY channel state information- Device- free localization and indoor human tracking - Activity and gesture recognition through RF.

**UNIT 3 LOW-POWER NETWORKING FILTERS****9 Hrs.**

Backscatter communication - Radio Frequency Identification (RFID) technology overview - Energy harvesting tags and applications- Internet-of-Things (IoT) - IoT protocol overview - CoAP and MQTT - IPv6 networking in low-power PANs (6LoWPAN).

**UNIT 4 FUTURE MOBILE NETWORKS****9 Hrs.**

Drone networking - multi-UAV networks, architectures and civilian applications-Communication challenges and protocols for micro-UAVs- Connected and autonomous cars - Wireless technologies for Vehicle-to-Infrastructure (V2I) and Vehicle-to- Vehicle (V2V) communications - Automotive surrounding sensing with GHz and THz signals.

**UNIT 5 QUALITY OF SERVICE****9 Hrs.**

QoS Challenges in Wireless IP Networks - QoS in 3GPP - QoS Architecture, Management and Classes -QoS Attributes - Management of End-to-End IP QoS - EPS Bearers and QoS in LTE networks.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the fundamental concepts of 5G networks.
- CO2** - Describe the 5G architecture and operation model.
- CO3** - Analyze the protocol support of 5G network.
- CO4** - Design IoT based applications with 5G network.
- CO5** - Describe the future mobile networks.
- CO6** - Implement 5G network with simulation.



**TEXT / REFERENCE BOOKS**

1. Wireless Communications: Principles and Practice, by Theodore S. Rappaport, Prentice Hall., 2014.
2. 802.11n: A Survival Guide, by Matthew Gast, O'Reilly Media.
3. 802.11ac: A Survival Guide, by Matthew Gast, O'Reilly Media.
4. Wireless Networking Complete, by Pei Zheng et al., Morgan Kaufmann.
5. Zhang, Yin, Chen, Min, "Cloud Based 5G Wireless Networks", Springer, 2016
6. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley 2015.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCSB4002	MALWARE ANALYSIS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To introduce the concepts of OS security and malware.
- To learn the fundamentals of malware analysis.
- To understand the concepts of static malware analysis.
- To understand the concepts of dynamic malware analysis
- To describe the malware functionality and detection techniques.

**UNIT 1 INTRODUCTION****9 Hrs.**

Introduction to malware, OS security concepts, malware threats, evolution of malware, malware types – viruses, rootkits, worms, bots, Trojans, spyware, adware, logic bombs, basic malware analysis, static malware analysis, dynamic malware analysis.

**UNIT 2 MALWARE ANALYSIS FUNDAMENTALS****9 Hrs.**

Assembling a toolkit for effective malware analysis - examining static properties of suspicious programs - performing behavioural analysis of malicious Windows executables - performing static and dynamic code analysis of malicious Windows executables - interacting with malware in a lab to derive additional behavioural characteristics.

**UNIT 3 STATIC MALWARE ANALYSIS****9 Hrs.**

Architecture of X86 - Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets, Antivirus Scanning - Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections.

**UNIT 4 DYNAMIC MALWARE ANALYSIS****9 Hrs.**

Malware Sandbox - running malware, Monitoring with Process Monitor, Packet Sniffing with Wireshark, source-level vs. assembly-level debuggers, Kernel vs. User-Mode Debugging, OLLYDBG - Breakpoints, Tracing, Exception Handling, Patching.

**UNIT 5 MALWARE FUNCTIONALITY AND DETECTION TECHNIQUES****9 Hrs.**

Downloaders – Backdoors - Credential Stealers - Persistence Mechanisms - Privilege Escalation - Covert malware launching – Launchers - Process Injection - Process Replacement - Hook Injection – Detours - APC injection - Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature - non-signature-based techniques: similarity-based techniques, machine-learning methods, invariant inferences.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the nature of malware, its capabilities and how gets combated through detection and classification.
- CO2** - Apply the tools and methodologies to perform static and dynamic analysis on unknown executables.
- CO3** - Analyse the static malware technique using reverse engineering.
- CO4** - Analyse the dynamic malware technique using debugger.
- CO5** - Use relevant tools to secure a network, respond to and follow up on various types of attacks.
- CO6** - Describe the malware functionality and detection techniques.

**TEXT / REFERENCE BOOKS**

1. Practical malware analysis, "The Hands-On Guide to Dissecting Malicious Software", by Michael Sikorski and Andrew Honig ISBN-10: 159327-290-1, ISBN-13: 978-1-59327-290-6, 2012.
2. Dang, Gazet and Bachaalany, "Practical Reverse Engineering", Wiley, 2014.
3. Computer viruses: From theory to applications by Filiol, Eric Springer Science & Business Media, 2006.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCSB4003	DESIGN AND DEVELOPMENT OF BLOCKCHAIN	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To understand how blockchain works in terms of Bitcoin and Ethereum.
- To learn about the various decentralized blockchain.
- To know the differences between proof of work and stake.
- To design and build own blockchain.
- To integrate own ideas with blockchain using Ethereum Wallet and Smart Contract.

**UNIT 1 BLOCKCHAIN BASICS****9 Hrs.**

Basics of Crypto economics- Blockchain – Cryptocurrencies overloaded –Blockchain in Nutshell: Benefits and Challenges – Blockchain types - Blockchain Peer to Peer Network: Consensus Mechanisms, Proof of Work, Proof of Stake, Mining Layer, Propagation Layer, Semantic Layer, Application Layer.

**UNIT 2 COMPONENTS AND STRUCTURE OF BLOCKCHAIN****9 Hrs.**

Blocks – Chain between the blocks – Digital signatures and Hashing – Block data examples: Bitcoin block, Ethereum block, Block time and Block size, Global Size – Blockchain miners and validators – Blockchain speed: Blockchain throughput and comparison with traditional network.

**UNIT 3 DECENTRALIZATION USING BLOCKCHAIN****9 Hrs.**

Methods of decentralization – Routes to decentralization – Blockchain and full ecosystem decentralization: Computation, Storage, Communication and decentralization – Smart Contracts – Organization of decentralization: Decentralized Autonomous: Organizations, Corporations, Societies, DApps and their requirements, Operations of DApps – Example of DApps: KYC-Chains, Open Bazaar, Lazooz.

**UNIT 4 CREATING AN OWN BLOCK CHAIN****9 Hrs.**

Creating: Basic P2P network, Genesis Blocks and Sharing Blocks – Registering Miners and Creating new blocks – Storing blocks – Creating: Blockchain wallet, API, Command Line Interface – Blockchain Wallet and Transaction: Wallet, Transaction and Colored Coins.

**UNIT 5 ETHEREUM WALLET & SMART CONTRACT****9 Hrs.**

Ganache Full node Client – Intellij Plugin for Solidity – Truffle Suite: Create your Smart Contract – Connect Truffle to Smart Contract – Smart Contract: Hello world, MD5 Smart Contract, Smart Contract with truffle, Deploy the Smart Contract to your deployment network – Truffle Console – Operation with your Smart Contract via the Truffle CLI – Cryptocurrency Mining: Mining Hardware, Miner Types, Mining Pools, Mining Software.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understanding emerging technology models of blockchain.
- CO2** - Known to deal with the component and structure of blockchain.
- CO3** - Deals to work with various decentralized blockchain.
- CO4** - Familiar with Ethereum wallet and smart contract.
- CO5** - Applications and implementation strategies.
- CO6** - Design and develop own blockchain for a real time application.

**TEXT /REFERENCE BOOKS**

1. EladElrom,"The Blockchain Developer A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects",Apress (2019).
2. Brenn Hill, Samanyu Chopra, Paul Valencourt, Narayan Prusty, "Blockchain Developer's Guide Develop Smart Applications with Blockchain Technologies - Ethereum, JavaScript, Hyperledger Fabric, and Corda",Packt Publishing (2018).
3. Salman A.Baset, LucDesrosiers, NitinGaur, PetrNovotny, AnthonyO'Dowd, Venkatraman Ramakrishna, "Hands-On Blockchain with Hyperledger Building Decentralized Applications with Hyperledger Fabric and Composer", Packt Publishing (2018).
4. Imran Bashir, Narayan Prusty, "Advanced Blockchain Development Build Highly Secure, Decentralized Applications and Conduct Secure Transactions",Packt Publishing (2019).

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCSB4004	IOT NETWORKS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To understand the technologies behind the IoT and Networking.
- To learn about IoT networking core technologies.
- To acquire knowledge about different networking protocols for IoT devices.
- To provide knowledge about networks of IoT devices using simulation.
- To provide experience to design and program solutions for energy efficient network of IoT devices.

**UNIT 1      IoT TECHNOLOGIES****9 Hrs.**

Introduction to IoT- Introduction, Physical Design of IOT, Logical design of IoT, IoT enabling Technologies, IoT Levels & Development Templates, Difference between IoT and M2M, SDN and NFV for IoT, Need for IoT systems management, Simple Network Management Protocol (SNMP), Network operator requirements.

**UNIT 2      IoT NETWORKING CORE****9 Hrs.**

IoT Networking Core Technologies involved in IoT development, Internet web and Networking technologies, Infrastructure, Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards, Wireless networking equipment and configurations.

**UNIT 3      NETWORK PROTOCOLS****9 Hrs.**

Layered networking models, Network protocols and architectures, Network security, Emerging network technologies, Standardisation of communication protocols, IoT networking: IPv6, 6LowPAN, CoAP, and various sensornets protocols.

**UNIT 4      SIMULATIONS****9 Hrs.**

Simulation on DNS using UDP sockets- ARP /RARP protocols-Simulation of Congestion Control Algorithms-Study of TCP/UDP performance using Simulation tool-Simulation of Distance Vector/ Link State Routing algorithm-Performance evaluation of Routing protocols using Simulation tool.

**UNIT 5      CASE STUDY****9 Hrs.**

Commercial building automation today & future, Automation in Industrial aspect of IOT- AirQ: Air Quality Analysis- Smart Parking –Smart Transport- Smart Healthcare-Smart Meters.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the basic concepts of IoT and Networking.
- CO2** - Recognize the various IoT platform and devices.
- CO3** - Learn the networking models and protocols.
- CO4** - Evaluate the different platforms for IoT application development.
- CO5** - Evaluate the network protocols using simulation tool.
- CO6** - Design and program solutions for energy-efficient networks of IoT devices.

**TEXT/REFERENCE BOOKS**

1. Virdis, Antonio, Kirsche, Michael (Eds.) "Recent Advances in Network Simulation, The OMNeT++ Environment and its Ecosystem" 2019, EAI/Springer Innovations in Communication and Computing.
2. Internet of Things: A Hands-On Approach Paperback – 2015, by Arsheep Bahga (Author), Vijay Madiseti (Author).
3. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things by Pearson Paperback – 16 Aug 2017, by Hanes David (Author), Salgueiro Gonzalo (Author), Grossetete Patrick (Author), Barton Rob (Author).
4. Authors: Kazim Ergun, Xiaofan Yu, Nitish Nagesh, Ludmila Cherkasova, Pietro Mercati, Raid Ayoub, Tajana Rosing, "RelIoT: Reliability Simulator for IoT Networks", Published in: Internet of Things - ICIOT 2020, Publisher: Springer International Publishing.
5. Jamil Y. Khan (Editor), Mehmet R. Yuce (Editor), Internet of Things (IoT): Systems and Applications 1st Edition, Publisher: Jenny Stanford Publishing; 1st edition (October 1, 2019).

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCSB4005	HARDWARE INTERFACES AND ITS APPLICATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To understand the components on the motherboard.
- To understand different storage media.
- Install and Repair computer system.
- Install Network devices, configuration, optimization.
- Understand the features of different I/O peripheral devices and their interfaces.

**UNIT 1 INTRODUCTION TO PC AND MEMORY****9 Hrs.**

Evolution of Personal Computers - Overview of Systems and Components - Processor Modes - Modern CPU Concepts - Architectural Performance Features - Intel Core X-Series Processor - CPU Over Clocking - Essential Memory Concepts - Memory Packages - Logical Memory Organizations - Memory Considerations - Memory Types - SSD - OPTANE Memory - Memory Techniques - Selecting and Installing Memory - CPU Coolers.

**UNIT 2 MOTHERBOARD DESIGNS****9 Hrs.**

Motherboard Form Factors - IBM PC XT - IBM PC AT - The Baby AT - Micro-AT - LPX and Mini-LPX - ATX - Mini-ATX - NLX - Active Motherboards - Sockets and Expansion Slots - DIMM.2 - M.2 Expansion Card - PCIE GEN3 M.2 - Intel D850GB - Upgrading a Mother Board - DDR4 BOOST - Chipsets - Intel -Non-Intel Chipsets - North Bridge - South Bridge - CMOS - Motherboard BIOS - RGB Headers - Live Dash OLED - NEXT GEN Connectivity 802.11 AD WIFI - USB 3.1 GEN2 Controller.

**UNIT 3 POWER SUPPLIES AND STORAGE DEVICES****9 Hrs.**

Power Supplies and Power Management - Modular - Non-Modular - Concepts of Switching Regulation - Potential Power Problems - Power Management -The Floppy Drive - Magnetic Storage - Floppy Drive - Hard Drive - SSD- CD-ROM Drive - DVD-ROM - DVD Media - DVD Drive and Decoder.

**UNIT 4 I/O PERIPHERALS AND BUS ARCHITECTURE****9 Hrs.**

Parallel Port - Signals and Timing Diagram - IEEE1284 Modes - Asynchronous Communication - Serial Port Signals - Video Adapters - Mice - Keyboards - Sound Cards - ISA - PCI - AGP.

**UNIT 5 NETWORK COMPONENTS****9 Hrs.**

Introduction of Network Cable - Ethernet Cable - FIBER Optics - HUB - Unmanageable Switch - Manageable Switch -Router - Modem - Wi-Fi - Access Point - PCI Wireless Card - USB Wireless Device - Print Server.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Explain the relationship between hardware and software.
- CO2** - Classify and explain the function of different computer hardware components.
- CO3** - Understand purpose and functions of networking.
- CO4** - Understand the purpose and functions of the computer peripherals.
- CO5** - Understand diagnostic procedures and troubleshooting techniques to personal computers, portable devices, operating systems and computer peripherals.
- CO6** - Simulate various Hardware interfaces.



**TEXT / REFERENCE BOOKS**

1. Stephen J Bigelow, "Trouble Shooting, maintaining and Repairing PCs", Tata McGraw-Hill.
2. Ron Gilster, "PC Hardware: A Beginner's Guide", Tata McGraw-Hill.
3. Craig Zacker and John Rourke, "The complete reference: PC hardware", Tata McGraw-Hill.
4. Mike Meyers, "Introduction to PC Hardware and Troubleshooting", Tata McGraw-Hill.
5. B.Govindarajulu, "IBM PC and Clones hardware trouble shooting and maintenance", Tata McGraw-Hill.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCSB4008	INTELLIGENT SYSTEMS ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- Understand the fundamental concepts and principles of intelligent systems engineering.
- Develop proficiency in designing and implementing intelligent systems using various techniques and methodologies.
- Apply intelligent systems engineering principles to solve real-world problems in diverse domains.

**UNIT 1 INTRODUCTION TO INTELLIGENT SYSTEMS ENGINEERING 9 Hrs.**

Introduction to intelligent systems-Components - Data Acquisition and Pre-processing- Knowledge Representation and Reasoning- Machine Learning and Data Analytics- Decision-Making and Control Systems- Human-Computer Interaction (HCI)-Applications of intelligent systems-Ethical considerations in intelligent systems.

**UNIT 2 MACHINE LEARNING AND DATA MINING 9 Hrs.**

Introduction to machine learning and data mining-Supervised and unsupervised learning algorithms-Feature extraction and dimensionality reduction-Data pre-processing and cleaning techniques-Evaluation and validation of machine learning models-metrics-Cross-validation-Over fitting and under fitting.

**UNIT 3 KNOWLEDGE REPRESENTATION AND REASONING 9 Hrs.**

Knowledge representation techniques- types of logical reasoning-semantic networks-Logic-based reasoning systems-Ontologies and semantic web-Reasoning under uncertainty-Expert systems and rule-based reasoning.

**UNIT 4 NATURAL LANGUAGE PROCESSING AND UNDERSTANDING 9 Hrs.**

Introduction to natural language processing (NLP)-Text pre-processing and tokenization-Syntax and semantic analysis-Named entity recognition and information extraction-techniques, challenges and applications-Machine translation and sentiment analysis.

**UNIT 5 INTELLIGENT SYSTEMS APPLICATIONS 9 Hrs.**

Intelligent systems in robotics and automation-Intelligent decision support systems (IDSS)-components, development, application-data mining and visualization-Intelligent transportation systems-Intelligent healthcare systems- clinical decision support system-Intelligent recommender systems-collaborative filtering-content based filtering-hybrid recommender systems.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Demonstrate an understanding of the fundamental concepts and principles of intelligent systems engineering.
- CO2** - Design and implement intelligent systems using various techniques and methodologies.
- CO3** - Apply intelligent systems engineering principles to solve real-world problems in diverse domains.
- CO4** - Analyze and evaluate machine learning models and data mining techniques for intelligent system development.
- CO5** - Develop proficiency in natural language processing and understanding for intelligent systems.
- CO6** - Apply ethical considerations and considerations for responsible AI development in the design and implementation of intelligent systems.

**TEXT / REFERENCE BOOKS**

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach," Pearson, 3rd edition, 2010.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective," MIT Press, 1st edition, 2012.
3. Dan Jurafsky and James H. Martin, "Speech and Language Processing," Pearson, 3rd edition, 2020.
4. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations of Computational Agents," Cambridge University Press, 3rd edition, 2020.
5. George F. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving," Pearson, 6th edition, 2009.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCSB4009	INTRODUCTION TO MACHINE LEARNING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To understand the concepts of machine learning.
- To appreciate Classification and Regression algorithms.
- To understand SVM and ANN algorithms.
- To know about probabilistic graphic models.

**UNIT 1 INTRODUCTION TO MACHINE LEARNING 9 Hrs.**

Machine Learning – Basic Concepts in Machine Learning – Types of Machine Learning – Examples of Machine Learning – Applications – The Bias-Variance - Data Pre-processing - Noise removal – Normalization - Principal Component Analysis – Independent Components Analysis.

**UNIT 2 SUPERVISED LEARNING 9 Hrs.**

Definition – Importance - Historical Evolution – Benefits - Promotion - barriers – Role of Industry, Government and Institutions - Environmental Management Hierarchy – Source Reduction techniques – Process and Equipment Optimization, Reuse, Recover, Recycle, Raw material substitution - Internet information and Other PP and CP Resources

**UNIT 3 SUPERVISED LEARNING TECHNIQUES & ENSEMBLE METHODS 9 Hrs.**

SVM Classifier – Soft and Hard Margin - Kernel Methods – Ensemble Methods – Bagging – Boosting – Reinforcement Learning – Model based Reinforcement Algorithms – Model-free Reinforcement Algorithms - Q-Learning and SARSA algorithms.

**UNIT 4 UNSUPERVISED LEARNING 9 Hrs.**

Clustering – K-means – Hierarchical Clustering – EM Algorithm in General – Model Selection for Latent Variable Models.

**UNIT 5 PROBABILISTIC GRAPHICAL MODELS 9 Hrs.**

Directed Graphical Models – Bayes Theorem – Naïve Bayesian Classifier – Laplacian approximation - Bayesian Networks – Markov Models – Hidden Markov Models – Inference – Learning-Generalization.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Implement a neural network for an application using an available tool.
- CO2** - Implement probabilistic discriminative and generative algorithms.
- CO3** - Use a tool to implement typical clustering algorithms for different types of applications.
- CO4** - Design an HMM for a sequence model type of application.
- CO5** - Implement a PGM for any real time application using an open-source tool.
- CO6** - Identify applications suitable for different types of machine learning with suitable justification.

**TEXT / REFERENCE BOOKS**

1. Sridhar S and Vijayalakshmi M, "Machine Learning", Oxford University Press, 2021.
2. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SCSB4010	IOT IN CLOUD ENVIRONMENT	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To Understand concept of IoT.
- To Understand the IoT Reference Architecture and Technologies.
- To Understand the various IoT Networks, Wi-Fi and Bluetooth.

**UNIT 1 INTRODUCTION TO IOT****9 Hrs.**

What is IoT, Genesis of IoT, Understanding IoT Devices, IoT and Digitization, IoT Architecture, IoT Impact, Convergence of IT and IoT, IoT Challenges, Layers of IoT, Understanding IoT Components, IoT Network Architecture and Design, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

**UNIT 2 IOT ARCHITECTURE & TECHNOLOGIES****9 Hrs.**

IoT architecture layers, IoT sensors types, actuator types, and RFID types, IoT device platforms Arduino, Raspberry Pi, and BeagleBoard.

**UNIT 3 CLOUD COMPUTING****9 Hrs.**

Introduction to Cloud Computing-Definition, Characteristics, Components, Introduction to Microsoft Azure, Cloud provider, SAAS, PAAS, IAAS and other Organizational scenarios of clouds.

**UNIT 4 IOT NETWORKS****9 Hrs.**

IoT network architecture, and wearable IoT networks, WLAN (Wireless Local Area Network), WPAN (Wireless Personal Area Network), and LPWAN (Low-Power Wide Area Network), WPAN (which include Bluetooth, ZigBee, 6LoWPAN, and IEEE 802.15.4 technology) and LPWAN (which include LoRa, UNB, Sigfox, and NB-IoT).

**UNIT 5 WI-FI & BLUETOOTH****9 Hrs.**

Wi-Fi technology, EDR (Enhanced Data Rate), HS (High Speed), BLE (Bluetooth Low Energy), and Beacon technology, Bluetooth piconets and types of operations.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Able to understand the concept of IoT Architecture.
- CO2** - Able to understand the types of IoT sensors.
- CO3** - Able to understand the concept of cloud Environment.
- CO4** - Learn about the different types of IoT networks.
- CO5** - To understand various technologies such as Wi-Fi and Bluetooth.

**TEXT / REFERENCE BOOKS**

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things – A Hands on Approach", Universities Press, 2015.
2. Kevin, Townsend, Carles, Cufí, Akiba and Robert Davidson, "Getting Started with Bluetooth Low Energy" O'Reilly.
3. Madhur Bhargava "IoT Projects with Bluetooth Low Energy, Packt Publishing, August 2017.
4. Robin Heydon, "Bluetooth Low Energy: The Developer's Handbook", Pearson, October 2012.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SCSB4011	CYBERSECURITY ESSENTIALS FOR ENGINEERS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To introduce the basic concepts of cyber security.
- To acquire knowledge on cyber threats and attacks.
- To become aware of significant security technologies and tools.
- To impart knowledge on cipher methods and cryptographic algorithms.
- To explore various protocols for establishing secured communication.

**UNIT 1 INTRODUCTION TO CYBERSECURITY****9 Hrs.**

Introduction – Need for Security – Security Approaches – Principles of Security – Components – Balancing Security & Access – Software Development Life Cycle – Security Systems Development Life Cycle – Security Professionals and the organization.

**UNIT 2 CYBERSECURITY – THREATS & ATTACKS****9 Hrs.**

Threats: Intellectual Property - Software Attacks – Deviations in QoS – Espionage – Forces of Nature – Human Error – Information Extortion – Missing, inadequate or incomplete organization policy – Missing, inadequate or incomplete controls – sabotage – Theft – Hardware Failures – Software Failures Attacks: Malicious Code – Hoaxes – Back Doors – Password Crack – Brute Force – Dictionary – DoS and DDoS – Spoofing – Man-in-the-Middle – Spam–Email Bombing – Sniffers – Social Engineering – Pharming – Timing Attack.

**UNIT 3 SECURITY TOOLS & TECHNOLOGIES****9 Hrs.**

Firewall and VPNs – Intrusion Detection and Prevention Systems – Other Security Tools - Access Control – Firewalls – Protecting Remote Connections, Honeypots, Honeynets and Padded Cell Systems.

**UNIT 4 CRYPTOGRAPHY****9 Hrs.**

Cryptology Terminology - Cipher methods – Cryptographic Algorithms – Cryptographic tools – Attacks on cryptosystems - Physical Security.

**UNIT 5 PROTOCOLS FOR SECURE COMMUNICATION****9 Hrs.**

Basic Concepts – SHTTP, SSL & SET – S/MIME, PEM & PGP – WEP, WPA & WPA2 – IPSEC & PGP

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the basic concepts, need, approaches, principles and components of security.
- CO2** - Explain the various cyber threats and attacks.
- CO3** - Describe the various Security Technologies and Tools.
- CO4** - Explain the basic principles of cryptography and algorithms.
- CO5** - Examine the various protocols for secure communication.
- CO6** - Explore the significant aspects of cybersecurity.



**TEXT / REFERENCE BOOKS**

1. Michael E. Whitman, Herbert J. Mattord, "Principles of Information Security", CENGAGE Learning, 4th Edition.
2. William Stallings, "Cryptography and Network Security – Principles and Practice", Pearson Education, 7th Edition.
3. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill, 4th Edition.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCSB4012	DECENTRALISED SYSTEMS AND BLOCKCHAIN TECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To understand the history, types and applications of Blockchain.
- To acquire knowledge about cryptography and consensus algorithms.
- Deploy projects using Web3j and design blockchain based applications.

**UNIT 1 INTRODUCTION TO DECENTRALIZED  
SYSTEMS and BLOCKCHAIN**
**9 Hrs.**

Centralized vs. decentralized systems-Advantages and challenges of decentralization-Distributed consensus and peer-to-peer networks-Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain – History, Definition, Distributed Ledger, Blockchain Categories – Public, Private, Consortium, Blockchain Network and Nodes, Peer-to-Peer Network, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain.

**UNIT 2 BLOCKCHAIN ARCHITECTURE****9 Hrs.**

Blocks, transactions, and the blockchain data structure Operation of Bitcoin Blockchain, Blockchain Architecture – Block, Hash, Distributer P2P, Structure of Blockchain- Consensus mechanism: Proof of Work (PoW), Proof of Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of Authority (PoA) and Proof of Elapsed Time (PoET).

**UNIT 3 BLOCKCHAIN-BASED FUTURES SYSTEM****9 Hrs.**

Project presentation- Futures smart contract: Blockchain oracles- Web3j: Setting up the Web3J- Installing web3j- Wallet creation, Java client: The wrapper generator- Initializing web3j- Setting up Ethereum accounts- Deploying the contract.

**UNIT 4 BLOCKCHAINS IN BUSINESS****9 Hrs.**

Public versus private and permissioned versus permission less blockchains- Privacy and anonymity in Ethereum- Why are privacy and anonymity important? - The Ethereum Enterprise Alliance- Blockchain-as-a-Service.

**UNIT 5 DISTRIBUTED STORAGE IPFS AND SWARM****9 Hrs.**

Ethereum Virtual Machine- Swarm and IPFS: Installing IPFS, hosting our frontend: Serving your frontend using IPFS, serving your frontend using Swarm, IPFS file uploader project: Project setup the web page.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Contentedly discuss and describe the history, types and applications of Blockchain.
- CO2** - Gains familiarity with cryptography and Consensus algorithms.
- CO3** - Create and deploy projects using Web3j.
- CO4** - Implement an ICO on Ethereum.
- CO5** - Design block chain-based application with Swarm and IPFS.
- CO6** - Address security and privacy concerns in decentralized systems and blockchain technology.

**TEXT / REFERENCE BOOKS**

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.
2. BellajBadr, Richard Horrocks, Xun (Brian) Wu, "Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger", Packt Publishing Limited, 2018.
3. Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media Inc, 2015
4. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCSB4013	INTRODUCTION TO DATA SCIENCE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration.
- To understand the basic types of data and basic statistics.
- To understand descriptive and inferential data analytics.
- To Identify the importance of data reduction techniques.
- To analysis and build predictive models from data.

**UNIT 1 INTRODUCTION****9 Hrs.**

Introduction - Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

**UNIT 2 DESCRIPTIVE STATISTICS****9 Hrs.**

Frequency distributions – Outliers –interpreting distributions – graphs – averages - describing variability – interquartile range – variability for qualitative and ranked data - Normal distributions – z scores – correlation – scatter plots – regression – regression line – least squares regression line – standard error of estimate – interpretation of  $r^2$  – multiple regression equations – regression toward the mean.

**UNIT 3 INFERENTIAL STATISTICS****9 Hrs.**

Populations – samples – random sampling – Sampling distribution- standard error of the mean - Hypothesis testing – z-test – z-test procedure –decision rule – calculations – decisions – interpretations - one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size.

**UNIT 4 ANOVA****9 Hrs.**

T-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Two-factor experiments – three f-tests – two-factor ANOVA –Introduction to chi-square tests.

**UNIT 5 PREDICTIVE ANALYTICS****9 Hrs.**

Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using Stats\_Models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values – serial correlation – autocorrelation.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand basic terms what Statistical Inference means.
- CO2** - Identify probability distributions commonly used as foundations for statistical modelling.
- CO3** - Describe the data using various statistical measures.
- CO4** - Analyse the variance in the data.
- CO5** - Perform data reduction techniques.
- CO6** - Build the model for predictive analytics.

**TEXT / REFERENCE BOOKS**

1. Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2022.
2. Vineet Raina, Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice", Apress, 2021.
3. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020.
4. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
5. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.
6. Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SCYB4001	APPLICATIONS OF PYTHON AND ARTIFICIAL INTELLIGENCE IN CHEMISTRY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- Provide an overview of Python programming and AI in chemistry, including their applications in data manipulation, predictive modeling, material science, and drug discovery.
- Introduce ChemPy for chemical analysis, reaction thermodynamics, kinetics, equilibrium, and optimization.
- Cover data analysis techniques with NumPy, Pandas, and RDKit libraries, including chemical database management and material design.
- Explore AI applications in synthetic organic chemistry for reaction prediction, knowledge extraction, novel molecule design, and synthetic route optimization.
- Demonstrate AI's utility in IR and NMR data analysis, including signal processing, peak detection, quantitative analysis, data mining, and predictive modeling.

**UNIT 1 INTRODUCTION TO PYTHON AND AI IN CHEMISTRY****9 Hrs.**

Introduction to Python Programming for Chemistry; Data Manipulation with Python Libraries; Introduction to Artificial Intelligence in Chemistry; Predictive Modeling with Machine Learning, AI-assisted Chemical Reaction Design; Machine Learning for Material Science; Applications of Python and AI in Drug Discovery.

**UNIT 2 INTRODUCTION TO CHEMPY****9 Hrs.**

Basic Python Programming for Chemical Analysis; Chemical Thermodynamics with ChemPy, Chemical Kinetics and Reaction Rates; Chemical Equilibrium and Reaction Enthalpies; Balancing Chemical Equations and Reaction Mechanisms; Optimization of Chemical Reactions with ChemPy, Simulation of Chemical Systems with ChemPy.

**UNIT 3 WORKING WITH CHEMICAL DATA****9 Hrs.**

Introduction to NumPy and Pandas libraries; Reading and writing chemical data files; Data visualization using Matplotlib and Seaborn libraries; Data manipulation and analysis using Pandas library; Chemical structure representation using RD Kit library; Predicting chemical reactivity; Chemical database management; Material design: Prediction of new materials, such as strength, conductivity, and thermal stability, based on their chemical composition.

**UNIT 4 AI IN SYNTHETIC ORGANIC CHEMISTRY****9 Hrs.**

Introduction to synthetic organic chemistry and retero synthesis; Prediction of reaction outcomes; Extraction of knowledge from literature; Design of novel molecules; Optimization of synthetic routes; Synthesis of complex molecules, taking into account factors such as reaction yield, cost, and safety.

**UNIT 5 AI IN IR AND NMR DATA ANALYSIS****9 Hrs.**

Signal processing: Removing background noise, correcting baseline drift. Classification and Peak detection of Functional groups. Quantitative analysis: Individual components in a mixture. Data mining: datasets of spectral data to identify patterns, trends, and correlations between different samples or experimental conditions. Predictive modeling: Predictive models based on spectral data to predict the properties of unknown compounds, such as chemical structure, melting point, and biological activity.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Recall the basic concepts of Python programming, chemical analysis, and AI techniques.
- CO2** - Comprehend the significance of Python programming and AI techniques in chemistry, chemical analysis, and synthesis.
- CO3** - Use Python programming and AI techniques to perform simple tasks, analyze chemical data, simulate chemical systems, predict reaction outcomes, design novel molecules, optimize synthetic routes, and analyze IR and NMR spectral data.
- CO4** - Evaluate the effectiveness of using Python programming and AI techniques in chemistry, chemical analysis, and synthesis.
- CO5** - Judge the benefits and drawbacks of using Python programming and AI techniques in chemistry, chemical analysis, and synthesis.
- CO6** - Generate innovative solutions using Python programming and AI techniques in chemistry, chemical analysis, and synthesis.

**TEXT / REFERENCE BOOKS**

1. Kiyoto Aramis Tanemura, Diego Sierra-Costa, and Kenneth M. Merz Jr. Python for Chemists, August 23, 2022; DOI:10.1021/acsinfocus.7e5030.
2. De Almeida, A. F., Moreira, R., & Tiago, R. (2019), Synthetic organic chemistry driven by artificial intelligence. Nature Reviews.Chemistry, 3(10), 589-604. doi:https://doi.org/10.1038/s41570-019-0124-0.
3. Gasteiger J. Chemistry in Times of Artificial Intelligence. Chemphyschem. 2020 Oct 16;21(20):2233-2242. doi: 10.1002/cphc.202000518. Epub 2020 Sep 28. PMID: 32808729; PMCID: PMC7702165.
4. Baskin, Igor &Madzhidov, Timur &Antipin, Igor &Varnek, Alexandre. (2017). Artificial Intelligence in Synthetic Chemistry: Achievements and Perspectives. Russian Chemical Reviews. 86. 10.1070/RCR4746.
5. Jonas, E., Kuhn, S., Schlörer, N., MagnReson Chem 2022, 60( 11), 1021. https://doi.org/10.1002/mrc.5234.
6. Li, C., Cong, Y., Deng, W., MagnReson Chem 2022, 60( 11), 1061. https://doi.org/10.1002/mrc.5292.
7. Abigail A. Enders, Nicole M. North, Chase M. Fensore, Juan Velez-Alvarez, and Heather C. Allen, Functional Group Identification for FTIR Spectra Using Image-Based Machine Learning Models, Analytical Chemistry 2021 93 (28), 9711-9718 DOI: 10.1021/acs.analchem.1c00867.
8. A Creative Commons Textbook for Teaching Scientific Computing to Chemistry Students with Python and Jupyter Notebooks J. Chem. Educ. 2021, 98, 489-494 DOI: 10.1021/acs.jchemed.0c01071.
9. Scientific Computing for Chemists: An Undergraduate Course in Simulations, Data Processing, and Visualization J. Chem. Educ. 2017, 94, 592-597 DOI: 10.1021/acs.jchemed.7b00078.
10. Introduction to Stochastic Simulations for Chemical and Physical Processes: Principles and Applications J. Chem. Educ. 2017, 94, 1904-1910 DOI: 10.1021/acs.jchemed.7b00395.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A :** 10 Questions of 2 marks each-No choice

**20 Marks**

**PART B :** 2 Questions from each unit with internal choice, each carrying 16 marks

**80 Marks**

SCYB4002	CHEM INTELLIGENCE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- Understand machine learning algorithms and their applications in chemistry.
- Apply regression and classification techniques to chemically relevant problems.
- Develop skills in feature selection, data preprocessing, feature engineering, and model validation for chemical datasets.
- Gain practical experience in predicting chemical properties using machine learning and learning from case studies in chemistry research.
- Learn about predicting physical properties and using computational tools for this purpose.
- Develop skills in synthetic organic chemistry and using machine learning for reaction outcome prediction and route optimization.

**UNIT 1 INTRODUCTION TO MACHINE LEARNING IN CHEMISTRY 9 Hrs.**

Overview of machine learning algorithms used in chemistry; Regression and classification techniques; Feature selection and model evaluation; Data pre-processing and cleaning; Feature engineering and selection; Model validation and evaluation.

**UNIT 2 HANDS-ON APPLICATIONS OF MACHINE LEARNING IN CHEMISTRY 9 Hrs.**

Hands-on activities using machine learning algorithms for predicting chemical properties Case studies on the use of machine learning in chemistry research.

**UNIT 3 PREDICTING PHYSICAL PROPERTIES 9 Hrs.**

Overview of methods used for predicting physical properties such as melting points, boiling points, and solubility; Hands-on activities using computational tools to predict physical properties; Introduction to toxicity prediction and related computational tools.

**UNIT 4 AI IN SYNTHETIC ORGANIC CHEMISTRY 9 Hrs.**

Introduction to synthetic organic chemistry and retrosynthetic analysis; Prediction of reaction outcomes using machine learning algorithms; Extraction of knowledge from literature for designing novel molecules; Optimization of synthetic routes considering factors such as reaction yield, cost, and safety.

**UNIT 5 AI IN IR AND NMR DATA ANALYSIS 9 Hrs.**

Introduction to signal processing techniques for IR and NMR data analysis; Classification and peak detection of functional groups; Quantitative analysis of individual components in a mixture; Data mining to identify patterns, trends, and correlations between different samples or experimental conditions; Predictive modeling based on spectral data to predict the properties of unknown compounds.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Recall and explain the different types of machine learning algorithms used in chemistry.
- CO2** - Understand and apply feature selection, model evaluation, and data preprocessing methods to a given dataset.
- CO3** - Apply machine learning algorithms and computational tools to predict physical properties of chemical compounds.
- CO4** - Apply machine learning algorithms to design novel molecules and optimize synthetic routes, and evaluate their safety, cost, and yield.



- C05** - Analyze and interpret datasets of spectral data, and develop predictive models for a specific chemistry problem based on spectral data.
- C06** - Evaluate the strengths, limitations, accuracy, and reliability of different machine learning techniques and computational tools used in chemistry, and develop novel approaches to solving chemistry problems using machine learning.

**TEXT / REFERENCE BOOKS**

1. De Almeida, A. F., Moreira, R., & Tiago, R. (2019), Synthetic organic chemistry driven by artificial intelligence. *Nature Reviews. Chemistry*, 3(10), 589-604. doi:<https://doi.org/10.1038/s41570-019-0124-0>.
2. Gasteiger J. Chemistry in Times of Artificial Intelligence. *Chemphyschem*. 2020 Oct 16;21(20):2233-2242. doi: 10.1002/cphc.202000518. Epub 2020 Sep 28. PMID: 32808729; PMCID: PMC7702165.
3. Baskin, Igor & Madzhidov, Timur & Antipin, Igor & Varnek, Alexandre. (2017). Artificial Intelligence in Synthetic Chemistry: Achievements and Perspectives. *Russian Chemical Reviews*. 86. 10.1070/RCR4746.
4. Jonas, E., Kuhn, S., Schlörer, N., *MagnReson Chem* 2022, 60( 11), 1021. <https://doi.org/10.1002/mrc.5234>.
5. Li, C., Cong, Y., Deng, W., *MagnReson Chem* 2022, 60( 11), 1061. <https://doi.org/10.1002/mrc.5292>.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SECB4001	ARTIFICIAL INTELLIGENCE SEARCH METHODS AND REASONING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To get introduced to the basic knowledge representation, problem solving, and learning methods of Artificial Intelligence.
- To familiarize with various search methods.
- To familiarize with Game Theory and Automated planning.

**UNIT 1 INTRODUCTION****9 Hrs.**

History, Can Machines think?, Turing Test, Winograd Schema Challenge, Language and Thought, Wheels & Gears, Philosophy, Mind, Reasoning, Computation, Dartmouth Conference, The Chess Saga, Epiphenomena.

**UNIT 2 STATE SPACE SEARCH****9 Hrs.**

Solution Space, TSP, Escaping Local Optima, Stochastic Local Search Population Based Methods: Genetic Algorithms, SAT, TSP, emergent Systems, Ant Colony Optimization Finding Optimal Paths: Branch & Bound.

**UNIT 3 HEURISTIC SEARCH****9 Hrs.**

Depth First Search, Breadth First Search, Depth First Iterative Deepening, Heuristic Search: Best First Search, Hill Climbing, A\*, Admissibility of A\*, Informed Heuristic Functions.

**UNIT 4 GAME PLAYING****9 Hrs.**

Game Theory, Board Games and Game Trees, Algorithm Minimax, AlphaBeta and SSS\*Domain Independent Planning, Blocks World, Forward & Backward Search, Goal Stack Planning, Plan Space Planning.

**UNIT 5 AUTOMATED PLANNING****9 Hrs.**

Problem Decomposition: Means Ends Analysis, Algorithm Graphplan, Algorithm AO\* Rule Based Expert Systems: Production Systems, Inference Engine, Match-Resolve-Execute, Rete Net.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the fundamental concepts of Artificial Intelligence.
- CO2** - Analyze various searching algorithms in AI.
- CO3** - Analyze the methods used for finding the Optimal paths.
- CO4** - Analyze the algorithms of problem decomposition.
- CO5** - Apply analytical concepts for solving logical problems using game theory.
- CO6** - Implement AI concepts for Automated planning.

**TEXT / REFERENCE BOOKS**

1. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.
2. Stefan Edelkamp and Stefan Schroedl. Heuristic Search: Theory and Applications, Morgan Kaufmann, 2011.
3. John Haugeland, Artificial Intelligence: The Very Idea, A Bradford Book, The MIT Press, 1985.
4. Pamela McCorduck, Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence, A K Peters/CRC Press; 2 edition, 2004.
5. Zbigniew Michalewicz and David B. Fogel. How to Solve It: Modern Heuristics. Springer; 2nd edition, 2004.
6. Judea Pearl. Heuristics: Intelligent Search Strategies for Computer Problem Solving, Addison-Wesley, 1984.
7. Elaine Rich and Kevin Knight. Artificial Intelligence, Tata McGraw Hill, 1991.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SECB4002	SOFTWARE TOOLS FOR ENGINEERING APPLICATIONS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To understand and gain complete knowledge about the fundamentals of MATLAB programming..
- To develop and translate mathematical concepts to MATLAB code.
- To provide data analytic skills by processing and visualization of data's.
- To design and develop Simulink and MATLAB models for specific engineering applications.

**UNIT 1 INTRODUCTION TO MATLAB****9 Hrs.**

Introduction To Matlab software-basic Features- Introduction to programming in MATLAB-M-File- Scripts- Input-Output commands - Creation and overwriting of Variables- Data types –Arithmetic, Relational & Logical operations - Example programs for operations- precedence of operators -Matrix generation and matrix arithmetic operation- Transposing a matrix - Concatenating matrices -Array Initialization and array arithmetic operations-Examples for Solving linear equations- Functions - User defined functions - passing arguments - using functions with vectors and matrices- cell arrays & structures - Strings - comparing - Concatenation.

**UNIT 2 LOOPS AND CONTROL STATEMENTS****9 Hrs.**

Control Flow & Decision statements- IF - IF ELSE - NESTED IF ELSE - SWITCH - TRY & CATCH - FOR - WHILE - NESTED FOR - FOR with IF statements, MATLAB program organization, Debugging methods- Setting and running with breakpoints – Examining values-Correcting and ending debugging, Example programs using the above commands. MISCELLANEOUS TOPICS: Date & Time Functions, Time Computations, File & Directory management.

**UNIT 3 PLOTS IN MATLAB AND GUI****9 Hrs.**

Basic 2D plots, Parametric & Implicit plots, subplot, LOG, LOG-LOG, SEMILOG-POLAR-COMET, exporting figures, HOLD, STEM, BAR, HIST, Interactive plotting, , axis labels, and annotations, Specifying line styles and colors, 3D plots – Mesh Surface- Contour –Plots with special graphics, View command, Plotting file data, Plotting from a function, GUI – Event based user interfaces, Matlab GUIDE, call back function, GUI controls, Example programs.

**UNIT 4 ADVANCED MATHEMATICAL APPLICATIONS****9 Hrs.**

Fitting Curves to Data -Polynomials, Addition, multiplication and division of polynomials, Roots and derivative of a polynomial, curve fitting, polyfit, Interpolation, Extrapolation, Least squares, basic fitting interface, Complex Numbers, Adding , Subtracting and Multiplying Complex Numbers, Integration and Differentiation, Trapezoidal Rule, Calculus in Symbolic Math Toolbox.

**UNIT 5 SIMULINK AND APPLICATIONS USING MATLAB****9 Hrs.**

Simulink- Introduction, Block setting, Model annotation, solver, sinks library, sources, math operations library, user defined functions and look up table in Simulink, ports and subsystems, masked sub system, program controls in Simulink: FOR, WHILE, IF, CASE, Signal routing and logical's, Exporting Simulink data to Matlab, Applications –Modelling of a simple PID controller using SIMULINK , Plotting the Frequency response of FIR & IIR filters using MATLAB.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Recall and recollect the basic programming fundamentals.
- CO2** - Implement various array arithmetic procedures.
- CO3** - Analyze and develop different control structures using MATLAB.
- CO4** - Evaluate different interactive plotting methods.
- CO5** - Identify the need for GUI based operations for real time programming.
- CO6** - Design and demonstrate applications based on communication systems, controllers etc.

**TEXT / REFERENCE BOOKS**

1. William J. Palm III, "Introduction to MATLAB for Engineers", 3rd Edition, McGraw Hill Publications, 2012.
2. Bansal R.K, Goel A.K., Sharma M.K., "MATLAB and its Applications in Engineering", Pearson Education, 2012.
3. Amos Gilat, "MATLAB-An Introduction with Applications", Wiley India, 2009.
4. Stephen.J.Chapman, "Programming in MATLAB for Engineers", Cengage Learning, 2011.
5. Robert Schilling & Sandra L.Harris, "Introduction to Digital Signal Processing using Matlab", Cengage Learning, 2014.
6. Cesar Perez Lopez, "Matlab Programming for Numerical Analysis", Springer Publications, 2014.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

<b>PART A</b> : 10 Questions of 2 marks each-No choice	<b>20 Marks</b>
<b>PART B</b> : 2 Questions from each unit with internal choice, each carrying 16 marks	<b>80 Marks</b>

SECB4003	DRONE ELECTRONICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To Introduce the Concepts of Applying Aerodynamics to Drone Design.
- To Familiarize the Student's Ability to Analyze the Concepts of Drone.
- To Understand the Basic Operation of Various Sensors in Drone Application.
- To Design Drone for The Mission Control Application.

**UNIT 1 INTRODUCTION TO DRONE****9 Hrs.**

Definition of drones , History of drones , Classification of drones based on structure- Fixed wing structure, Lighter than air systems and Rotary-wing aircraft, Application of drones, Parts of Drone system, System design, Mechanical design, hardware design, software architecture, Logistic and Operations Management.

**UNIT 2 DYNAMICS AND STABILITY****9 Hrs.**

Forces of flight, Principal axes and rotation of aerial systems - Longitudinal axis, Lateral(transverse) axis and Perpendicular axis, Equilibrium, Stability - Stable system, Unstable system and neutrally stable system, Control – Roll, Pitch, Yaw and Throttle.

**UNIT 3 SENSORS IN DRONE****9 Hrs.**

Sensors – Accelerometer, Barometer, Gyro Sensor, Magnetometer, Distance sensors, Time of Flight (ToF) Sensors, Thermal sensors, Chemical Sensors and thermal sensors. Sensor Testing – Test Philosophies and methodologies, Test equipment, Performance testing of sensors.

**UNIT 4 GLIDING DRONE****9 Hrs.**

Glider, Lift, Drag, Airfoil and its type, Incident and decalage angle, three axis motion (roll, pitch, and yaw), Thrust, Aspect ratio and glide ratio, Glide or dive and descent, gliding angle, Climb, Center of pressure, pitching moment, Load factor, Angle of attack, Build our own glider drone.

**UNIT 5 DRONES FOR MISSION CONTROL APPLICATIONS****9 Hrs.**

ESP8266, Downloading and installing APM Planner or Mission Planner, Configuring the quadcopter - Frame type selection, Compass calibration, Access calibration, Radio calibration, Flight mode calibration and Failsafe calibration, Surveying with a drone, tweaks with the Flight Plan screen. Future of Drone Systems.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Apply the mathematical/engineering concepts in building drones.
- CO2** - Analyze the mathematical relation between force, equilibrium, stability and the movement of drones.
- CO3** - Select appropriate sensors and actuators for specific applications.
- CO4** - Design gliding drones for real world applications.
- CO5** - Appraise the performance of subunits in drones.
- CO6** - Design a drone for mission control application.

**TEXT / REFERENCE BOOKS**

1. Syed Omar Faruk Towaha, "Building Smart Drones with ESP8266 and Arduino: Build exciting drones by leveraging the capabilities of Arduino and ESP8266" Packt Publishing, 2018.
2. Aaron Asadi, "Drones The Complete Manual. The essential handbook for drone enthusiasts", Imagine Publishing Limited, 2016.
3. Neeraj Kumar Singh, PorselvanMuthukrishnan, Satyanarayana Sanpini, "Industrial System Engineering for Drones: A Guide with Best Practices for Designing", Apress, 2019.
4. Felipe Gonzalez Toro, AntoniosTsourdos, "UAV or Drones for Remote Sensing Applications"2018.
5. K R Krishna, "Agricultural Drones: A Peaceful Pursuit", Apple Academic Press; CRC Press, 2018.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SEEB4001	SMART GRID	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To understand various aspects of smart grid.
- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high-performance computing for Smart Grid applications.

**UNIT 1 INTRODUCTION TO SMART GRID****9 Hrs.**

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid, Diverse Prospective from experts and global Smart Grid initiatives.

**UNIT 2 SMART GRID ARCHITECTURE****9 Hrs.**

Components and Architecture of Smart Grid Design –Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs – Transmission Automation – Distribution Automation –Renewable Integration.

**UNIT 3 SMART METERS AND ADVANCED METERING INFRASTRUCTURE****9 Hrs.**

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

**UNIT 4 POWER QUALITY MANAGEMENT IN SMART GRID****9 Hrs.**

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

**UNIT 5 HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS****9 Hrs.**

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Comprehend the concepts of Smart Grid and its present developments.
- CO2** - Analyze the various Smart Grid technologies.
- CO3** - Interpret about different smart meters and advanced metering infrastructure.
- CO4** - Realize the power quality management in Smart Grids.
- CO5** - Examine the concepts of various network.
- CO6** - Investigate Cloud Computing for Smart Grid applications.



**TEXT / REFERENCE BOOKS**

1. Stuart Borlase "Smart Grid: Infrastructure, Technology and Solutions", CRC Press 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley, 2012.
3. Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, "Smart Grid Technologies: Communication Technologies and Standards", IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
4. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey", IEEE Transaction on Smart Grids, Vol. 14, No. 4, pp. 944-980, 2012.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SEEB4002	ELECTRIC VEHICLE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To understand the concept of conventional vehicle.
- To acquire the knowledge about the electric vehicle.
- Apply the control of control techniques for motors.
- To understand the transmission system used in electric vehicle.
- To acquire the knowledge about the battery charging system.

**UNIT 1 VEHICLE FUNDAMENTALS****9 Hrs.**

General Description of Vehicle Movement, Vehicle Resistance, Dynamic Equation, Tire–Ground Adhesion and Maximum Tractive Effort, Power Train Tractive Effort and Vehicle Speed-Vehicle Power Plant and Transmission Characteristics-Vehicle Performance-Braking Performance.

**UNIT 2 ELECTRIC VEHICLE FUNDAMENTALS****9 Hrs.**

EV Types, EV Configurations, Energy Sources, Motors Used- construction-principal operation-Characteristics-Classification-DC motor, Induction motor, PMBLDC motor, PMSM, SRM and Synchronous reluctance motor, Charging Systems, Power Conversion Techniques, Technological Problems, Control Algorithms, Trends and Future Developments.

**UNIT 3 ELECTRIC POWER TRAIN****9 Hrs.**

Series Hybrid Electric Drive Train Design-Sizing of the Major Components- The Hybrid Electric Vehicle-Energy Use in Conventional Vehicles-Energy Savings Potential of Hybrid Drive trains-HEV Configurations-Series Hybrid System-Parallel Hybrid System-Series-Parallel System-Complex Hybrid System.

**UNIT 4 ELECTRIC PROPULSION SYSTEM****9 Hrs.**

DC motor drive-Chopper control of DC motor drive- multi-quadrant control of Chopper fed drive Induction motor drive-constant v/f control-power electronics control-FOC-VSI for FOC. PMBLDC motor drive - performance and control of PMBLDC machine. SRM drive- SRM drive converter-modes of operation-generating modes of operation.

**UNIT 5 BATTERY STORAGE AND CHARGING****9 Hrs.**

Batteries-Overview-Types of battery-Fuel Cell-Super capacitor -Flywheel. Charging, standards and infrastructure-Wireless power transfer-Solar charging case study. Case studies-General motor EV-1 and Tesla roadster.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Apply Vehicle concept to electric vehicle.
- CO2** - Analyze the power conversion technique of electric vehicle.
- CO3** - Examine the performance of different electric drive train.
- CO4** - Select the appropriate electric motor for electric propulsion system.
- CO5** - Select a suitable battery for electric vehicle.

**C06** - Investigate the recent technique used in modern electric vehicle.

**TEXT / REFERENCE BOOKS**

1. M. Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005 Suggested Reading.
2. Tom Denton, Electric and Hybrid vehicle routledge, 2016.
3. Husain, Electric and Hybrid Electric Vehicles, CRC Press, 2003.
4. Un-Noor, F., Padmanaban, S., Mihet-Popa, L., Mollah, M.N. and Hossain, E., 2017. A comprehensive study of key electric vehicle (EV) components, technologies, challenges, impacts, and future direction of development. Energies, 10(8), p.1217.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A** : 10 Questions of 2 marks each-No choice

**20 Marks**

**PART B** : 2 Questions from each unit with internal choice, each carrying 16 marks

**80 Marks**

SEEB4003	GREEN ENERGY SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To understand the need and advantages of renewable energy.
- To study the performance, efficiency and the relevancy to the future energy needs.

**UNIT 1 INTRODUCTION****9 Hrs.**

Overview of conventional & renewable energy sources, need, potential & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Present Indian and international energy scenario of conventional and RE sources, Energy for sustainable development, Environmental Aspects of Energy, Limitations of RE sources.

**UNIT 2 SOLAR ENERGY****9 Hrs.**

Theory of solar cells - VI and PV curves - Equivalent circuit. Concept of solar PV module, Panel, Array, Maximum Power Point tracking-Solar PV systems-Solar Collectors Classifications—Solar PV Applications-Solar Refrigeration - Solar Pond Power Plant - Solar Thermal Power Plant.

**UNIT 3 WIND ENERGY****9 Hrs.**

Wind Power and its Sources-Energy from Wind - Horizontal axis Wind Turbine - Vertical Axis Wind Turbine - Wind Energy Conversion Systems - Cp Vs Speed Curve.

**UNIT 4 HYDROGEN PRODUCTION AND HYDROGEN STORAGE****9 Hrs.**

Chemical Production of Hydrogen- Electrolytic Hydrogen- Thermolytic Hydrogen- Photolytic Hydrogen- Photo biologic Hydrogen Production- Compressed Gas- Cryogenic Hydrogen- Storage of Hydrogen - Adsorption- Chemical Compounds- Hydride Hydrogen Compressors- Hydride Heat Pumps.

**UNIT 5 HYBRID RENEWABLE ENERGY SYSTEMS****9 Hrs.**

Need for Hybrid Systems- Range and type of Hybrid systems - Configuration and Coordination, Electrical interface: wind-PV, Wind-PV-Fuel cell -Power quality issues in Hybrid Energy System.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Discuss various energy sources and their environmental issues.
- CO2** - Sketch the limitless availability of green energy sources.
- CO3** - Interpret solar energy conversion and their benefits.
- CO4** - Select available possibilities for building a small range of wind energy conversion system.
- CO5** - Analyze hydrogen production method and storage methods.
- CO6** - Formulate the challenges in renewable hybrid system.

**TEXT / REFERENCE BOOKS**

1. Aldo Vieira da Rosa, Juan Carlos Ordonez, "Fundamentals of Renewable Energy Processes" - Elsevier academic press 4th Edition 2021.
2. Janaka Ekanayake and Nicholas Jenkins "Renewable Energy Engineering"- Cambridge university press-2017.
3. B Khan, "Non conventional Energy resources", Tata McGraw Hill, 2nd Edition 2009.
4. Mukund R. Patel, Wind & Solar Power Systems- Design, Analysis and Operation, Taylor and Francis, 2nd Edition 2005.
5. James Larminie & Andrew Dicks, "Fuel Cell Systems Explained", John Wiley & Sons, 2nd Edition.
6. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
7. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.
8. K R Krishna, "Agricultural Drones: A Peaceful Pursuit", Apple Academic Press; CRC Press, 2018.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SITB4001	ARTIFICIAL INTELLIGENCE & MACHINE LEARNING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To learn the basic AI approaches and to develop problem solving agents.
- To understand the basic concepts of Machine Learning and build on the construction and study of algorithms that can learn from data.
- To evaluate the algorithms based on corresponding metrics identified.

**UNIT 1 INTELLIGENT AGENTS****9 Hrs.**

Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies.

**UNIT 2 PROBLEM SOLVING****9 Hrs.**

Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments.

**UNIT 3 INTRODUCTION TO MACHINE LEARNING****9 Hrs.**

Machine learning - examples of machine learning applications - Learning associations - Classification - Regression –Unsupervised learning-Supervised Learning-Learning class from examples-PAC learning-Noise, model selection and generalization-Dimension of supervised machine learning algorithm.

**UNIT 4 NEURAL NETWORKS****9 Hrs.**

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

**UNIT 5 DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS****9 Hrs.**

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Explain intelligent agent frameworks.
- CO2** - Apply problem solving techniques.
- CO3** - Explain the basic concepts of machine learning.
- CO4** - Construct supervised learning models.
- CO5** - Construct unsupervised learning algorithms.
- CO6** - Evaluate and compare different models.

**TEXT / REFERENCE BOOKS**

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", IVth Edition, Pearson Education, 2021.
2. M.TimJones, "ArtificialIntelligence:ASystemsApproach(ComputerScience)", JonesandBartlett Publishers, Inc., FirstEdition, 2008.
3. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
4. TomMitchell, "MachineLearning", McGrawHill, 1997.
5. Shai Shalev-Shwartz and ShaiBen David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge, UniversityPress, 2014.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice** **20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks** **80 Marks**

SITB4002	USER INTERFACE DESIGN	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To explain hypertext and style sheet languages and apply RWD.
- To illustrate the basics of JavaScript, AJAX.
- To build Server side JS frameworks & Angular JS frameworks.

**UNIT 1 UI DESIGN****9 Hrs.**

HTML5: What is HTML5 - Features of HTML5 – Semantic Tags – New Input Elements and tags - Media tags(audio and video tags) – Designing Graphics using Canvas API - Drag and Drop features – Geo location API – Web storage(Session andlocalstorage).CSS3:What isCSS3,–FeaturesofCSS3–Implementationofborderradius,boxshadow,imageborder,customwebfont,backgrounds-Advanced text effects (shadow) - 2D and 3D Transformations.

**UNIT 2 RESPONSIVE WEB DESIGN (RWD)****9 Hrs.**

Responsive Design: What is RWD – Introduction to RWD Techniques – Fluid Layout, Fluid Images and Mediaqueries-Introduction to RWD Framework. Twitter Bootstrap–Bootstrap Background and Features-Getting Started with Bootstrap-Demystifying Grids–Off Canvas-Bootstrap Components-JS Plugins–Customization.

**UNIT 3 INTRODUCTION TO JAVASCRIPT AND AJAX****9 Hrs.**

Introduction-Corefeatures – Data types and Variables-Operators, Expressions and Statements-Functions & Scope- Objects - Array, Date and Math related Objects - Document Object Model - Event Handling – Browser Object Model - Windows and Documents - Form handling and validations. Object-Oriented Techniques in JavaScript -Classes – Constructors and Prototyping (Sub classes and Super classes) – JSON – Introduction to AJAX.

**UNIT 4 INTRODUCTION TO SERVER-SIDE JSFRAMEWORK – NODE.JS****9 Hrs.**

Introduction - What is Node JS – Architecture – Feature of Node JS - Installation and Setup - Creating web serverswith HTTP (Request & Response) – Event Handling - GET & POST implementation - Connect to SQL Database usingNodeJS–ImplementationofCRUDoperations.

**UNIT 5 INTRODUCTION TO CLIENT-SIDE JS FRAMEWORK****9 Hrs.**

IntroductiontoAngular4.0-Needs & Evolution –Features–Setup and Configuration –Components and Modules – Templates – Change Detection – Directives – Data Binding - Pipes – Nested Components. Template - Model DrivenForms or Reactive Forms - Custom Valuator.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Develop webpages and stylesheets using HTML and CSS3 respectively.
- CO2** - Design responsive websites with RWD techniques.
- CO3** - Apply JavaScript and allied scripting languages for implementing object models and functions.
- CO4** - Demonstrate ServeSide JS Framework for application development.
- CO5** - Use Client-Side JS Framework for redefining the application development.
- CO6** - Develop User Interface Designs using the frameworks.



**TEXT / REFERENCE BOOKS**

1. Harvey and Paul Deitel & Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web- How to Program", 5<sup>th</sup> Edition, Pearson Education, 2011.
2. Achyut S Godbole and Atul Kahate, "Web Technologies", 2<sup>nd</sup> Edition, Tata McGraw Hill, 2012.
3. Thomas A Powell, Fritz Schneider, "JavaScript: The Complete Reference", 3<sup>rd</sup> Edition, Tata McGraw Hill, 2013.
4. David Flanagan, "JavaScript: The Definitive Guide, 6<sup>th</sup> Edition", O'Reilly Media, 2011.
5. Bear Bibeault and Yehuda Katz, "jQuery in Action", January 2008.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMEB4001	WIND AND SOLAR ENERGY	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To understand the fundamentals of wind energy and its conversion system.
- To learn and study the solar radiation and various solar collectors.

**UNIT 1 WIND ENERGY FUNDAMENTALS & WIND MEASUREMENTS 9 Hrs.**

History of wind power, Indian and Global statistics, Wind Energy Basics, Wind Speeds and scales, Terrain, Roughness, Wind Mechanics, Power Content, Class of wind turbines, Atmospheric Boundary Layers, Turbulence. Instrumentation for wind measurements, Wind data analysis, tabulation, Wind resource estimation, Betz's Limit, Turbulence Analysis.

**UNIT 2 AERODYNAMICS THEORY & WIND TURBINE TYPES 9 Hrs.**

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Airfoil terminology, Blade design, Rotor performance and dynamics, Balancing technique (Rotor & Blade), Types of loads; Sources of loads Vertical Axis Type, Horizontal Axis, Constant Speed Constant Frequency, Variable speed Variable Frequency, Up Wind, Down Wind, Stall Control, Pitch Control, Gear Coupled Generator type, Direct Generator Drive /PMG/Rotor Excited Sync Generator.

**UNIT 3 WIND TURBINE COMPONENTS AND THEIR CONSTRUCTION 9 Hrs.**

Electronics Sensors /Encoder /Resolvers, Wind Measurement : Anemometer & Wind Vane, Grid Synchronisation System, Soft Starter, Switchgear [ACB/VCB], Transformer, Cables and assembly, Compensation Panel, Programmable Logic Control, UPS, Yaw & Pitch System : AC Drives, Safety Chain Circuits, Generator Rotor Resistor controller (Flexi Slip), Differential Protection Relay for Generator, Battery/Super Capacitor Charger & Batteries/Super Capacitor for Pitch System, Transient Suppressor/Lightning Arrestors, Oscillation & Vibration sensing.

**UNIT 4 SOLAR RADIATION AND MEASUREMENT 9 Hrs.**

Energy from Sun – Solar Constant –Sun earth relationship – Spectral distribution of Extra-terrestrial Radiation – Variation of Extra-terrestrial Radiation – Solar angles–Sun path diagrams– Solar Time and its equation –Air mass ratio – Radiation reaching Earth's surface – Measurement and estimation on horizontal and tilted surfaces –Measurement devices for Solar Radiation, temperature-efficiency measurements-high efficiency cells–Solar thermo-Photovoltaic.

**UNIT 5 SOLAR COLLECTORS 9 Hrs.**

Flat plate collector thermal analysis – Testing Methods-Evacuated tubular collectors –Concentrating collectors – Classification- Design and performance parameters-Tracking systems- Compound parabolic concentrators – Parabolic trough Concentrators-Concentrators with point focus-Heliostats– performance of the collectors.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Determine energy available in wind and limitations in wind turbine design.
- CO2** - Analyze the wind turbine aerodynamics and breaking system.
- CO3** - Explain about various components of wind turbine and its working.
- CO4** - Illustrate solar radiation and its measurement.
- CO5** - Identify various solar thermal energy technologies and their applications.
- CO6** - Compare various solar PV cell materials and interpret factors influencing of conversion efficiency.

**TEXT / REFERENCE BOOKS**

1. C-WET: Wind Energy Resources Survey in India.
2. John D Sorensen and Jens N Sorensen, Wind Energy Systems, Wood head Publishing Ltd, 2011.
3. Kaldellis. J.K, Stand-alone and Hybrid Wind Energy Systems, CRC Press, 2010.
4. Chetan Singh Solanki, Solar Photo voltatics – Fundamentals, Technologies and Applications, PHI Learning Private limited, 2011.
5. John A.Duffie, William A.Beckman, Solar Engineering of Thermal Processes, John Wiley & Sons, 2013.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A : 10 Questions of 2 marks each-No choice** **20 Marks**

**PART B : 2 Questions from each unit with internal choice, each carrying 16 marks** **80 Marks**

SMEB4002	INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To teach students the basics of robotics and Automation Systems.
- To teach students robot cell design, Robot Configuration and robot programming.
- To teach students application of artificial intelligence and expert systems in robotics.

**UNIT 1 INTRODUCTION AND ROBOT KINEMATICS****9 Hrs.**

Definition need and scope of industrial robots – Coordinate Systems Classification of Robot – Robot anatomy – work volume – Precision movement–End effectors-sensors. Robot kinematics–Basics about plane rotation–rotate on matrix – Direct and inverse kinematics – Robot Trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects. Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load.

**UNIT 2 ROBOT DRIVES****9 Hrs.**

Controlling the robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives- D.C.Servo Motors, Stepper Motors, A.C. Servo Motors Linear and rotary actuators and control valves, electric drives – Motors–SelectionofDrives-designingofendeffectors-Vacuum,magneticandair operated grippers.

**UNIT 3 ROBOT SENSORS & IMAGE PROCESSING****9 Hrs.**

Robot Sensors-Proximity sensors – Touch sensors-range sensors- temperature sensors-introduction to image processing- Robotic vision system - Image Gripping - Image processing and analysis - Image segmentation – Pattern recognition - Training of vision system.

**UNIT 4 ROBOT CELL DESIGN AND FIELD ROBOTS****9 Hrs.**

Robot work cell design and control - Safety in Robotics - Robot cell layouts - Multiple robots and machine interference - Robot cycle time analysis - Ariel robots- Collision Avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

**UNIT 5 ROBOT PROGRAMMING****9 Hrs.**

Methods of robot programming - characteristics of task level languages- lead through programming- Methods-Motion interpolation. Different Programming Languages – basic motion commands – MOVEJ, MOVEJ, MOVEJ, WAIT, SIGNAL, DELAY Commands.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Describe Fundamental Concepts of Robots and Kinematics.
- CO2** - Implement Drives concepts in End effectors.
- CO3** - Analyze and design Path planning and Image processing.
- CO4** - Design robot work cell for automation industries.
- CO5** - Understand the robot programming methods.
- CO6** - Understand the concepts of various commands.

**TEXT / REFERENCE BOOKS**

1. K.S.Fu, R.C Gonzalez and C.S.G.Lee, Robotics control, Sensing, Vision and intelligence", Mc Graw Hil, 2010.
2. Kozyrey, Yu, "Industrial Robotics", MIR Publishers Moscow, 2022.
3. Richard.D.,Klafter, Thomas.A, Chmielewski, Machine Negin "Robotics Engineering-An Integrated Approach", Prentice Hall of India,2009.
4. Deb,S.R. "RoboticsTechnologyandFlexibleAutomation", TataMcGrawHill,2018.
5. Mikell,P.Groover,MitchellWeis,RogerN.Nagel,NicholasOdrey"IndustrialRoboticsTechnology, Programming and Applications", McGraw Hill, Int., 2021.
6. TimothyJordonidesetal,"ExpertSystemsandRobotics", Springer-Verlag,NewYork,May2018.
7. Ashitave Ghosal "Robotics–Fundamental concepts and Analysis" Oxford University Press, 2006.
8. KorenY, "Robotics for Engineers', McGraw Hill Book Co.,2019.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMEB4003	INDUSTRIAL SAFETY ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To understand the safety functions and safety audit.
- To understand the types of operational safety like hot metal operation and cold metal operation.
- To understand the safety consideration with health, Welfare Act.
- To learn the safety performance monitoring and management techniques.

**UNIT 1 INTRODUCTION TO INDUSTRY****9 Hrs.**

Evaluation of modern safety concepts - Safety management functions - safety organization, safety department - safety committee, safety audit - performance measurements and motivation - employee participation in safety - safety and productivity.

**UNIT 2 OPERATIONAL SAFETY****9 Hrs.**

Hot metal operation – safety in Cutting – safety in welding – safety in Boilers- Pressure vessels – Furnace (all types) - Heat treatment processes shops – electroplating – grinding – forming processes- rolling – forging - surface hardening – casting – Moulding – coiling. Operational safety (cold metal operation), Safety in Machine shop - Cold bending and chamfering of pipes - metal cutting - shot blasting, grinding, painting - power press and other machines.

**UNIT 3 SAFETY, HEALTH, WELFARE AND LAW****9 Hrs.**

Features of Factory Act – explosive Act – boiler Act – ESI Act – workman's compensation Act – industrial hygiene – occupational safety – diseases prevention – ergonomics - Occupational diseases, stress, fatigue - Health, safety and the physical environment - History of legislations related to Safety-pressure vessel act- Indian boiler act - The environmental protection act - Electricity act - Explosive act.

**UNIT 4 PERSONAL PROTECTIVE EQUIPMENT****9 Hrs.**

Introduction, Selectivity of PPE, Protective Equipment for Eyes, Types, Protection of Face, Eye, Arms, Hands, Fingers, Foot, Legs, Head, Ears and Respiration System, Safety Belt for Industrial Operation.

**UNIT 5 SAFETY MANAGEMENT****9 Hrs.**

Methods of promoting safe practice – Safety organization- OSHA – Safety controls. visible and latent hazards - human factors and safety - safety audit - Case study roll of management and roll of Govt. in industrial safety - safety analysis Industrial fatigue- role of industrial psychology- risk analysis - safety training - accident and near miss investigations- promotional measures to avoid accidents - human reliability - safety management characteristics-industrial safety policies and implementation.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the safety audit committee and management functions.
- CO2** - Evaluate the modern safety concepts, measurements and motivations.
- CO3** - Obtain knowledge on different types of operational safety in hot metal and cold metal working process,
- CO4** - Analyze function and uses of the personal protective equipments.
- CO5** - Examine the safety performance monitoring and evaluations of accident rate.
- CO6** - Analyze and implementing management techniques.

**TEXT / REFERENCE BOOKS**

1. R.K.Jain, Industrial safety, Health and Environmental Management System, Khanna Publishers, First reprint, 2017.
2. Deshmukh, Industrial Safety Management, Tata McGraw Hill, New edition, 2017.
3. Thomas D. Schneid, Legal Liabilities in Safety and Loss Prevention, CRC Press, 3rd Edition, 2019.
4. Roy Asfatil C, David W Rieske, Industrial safety and Health Management, Pearson, 7th Edition, 2018.
5. Joseph F. Gustin, Safety Management: A Guide for facility Management, River Publisher, 2008.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A : 10 Questions of 2 marks each-No choice** **20 Marks**

**PART B : 2 Questions from each unit with internal choice, each carrying 16 marks** **80 Marks**

SMRB4001	INTRODUCTION TO MECHATRONICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To create a strong base on the various sensors and transducers in mechanical system.
- To learn interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems.
- To design control system for computer application like CNC.

**UNIT 1 INTRODUCTION****9 Hrs.**

Mechatronics: Definition, introduction to mechatronics, review of basic electronics and Key Issues - Evolution - Elements - Mechatronics Approach to Modern Engineering, Industrial design and safety Design.

**UNIT 2 SENSORS AND TRANSDUCERS****9 Hrs.**

Introduction and background, difference between transducer and sensor, transducers types, transduction principle, photoelectric transducers- thermistors, thermos devices, thermocouple, inductive transducers capacitive transducers, piezoelectric transducers, piezoelectric transducers. Hall Effect transducers, Fiber optic transducers, Signal Processing - Data Display.

**UNIT 3 ACTUATION SYSTEMS****9 Hrs.**

Introduction to Mechanical Types and Electrical Types - Pneumatic & Hydraulic Systems - Applications - Selection of Actuators, Actuators for mechatronic applications, Kinematics of robot manipulator links.

**UNIT 4 DIGITAL AND CONTROL SYSTEMS****9 Hrs.**

Digital logic neuron system, Types of Controllers - Programmable Logic Controllers - applications - ladder diagrams - Microprocessor Applications in Mechatronics: Temperature measurement system, Domestic washing machine - Programming Interfacing - Computer Applications: CNC drilling machine.

**UNIT 5 RECENT ADVANCES****9 Hrs.**

Digital electronics, basic logic functions, logic gates, logic ICs, Biomedical robotics and applications, Manufacturing Mechatronics - Automobile Mechatronics - Medical Mechatronics - Office Automation – Case Studies.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand the approach of Mechatronics to engineering concepts.
- CO2** - Classify the different types of sensors, transducers.
- CO3** - Explains the actuator and use of robot kinematics.
- CO4** - Distinguish the different control and interfacing techniques.
- CO5** - Analyses the applications of mechatronics in the fields of automobile, robotics, medicine.
- CO6** - Identification of key elements of mechatronics system and its representation in terms of block diagram.



**TEXT / REFERENCE BOOKS**

1. Bolton. W "Mechatronics: Electronic Control System for Mechanical & Electrical Engineering", 2nd Edition Pearson Education, 2004.
2. Hystand, M. B., Alciatore, D. G. (2007). Introduction to Mechatronics and Measurement Systems 3rd ed., WCB/McGraw-Hill, Boston. ISBN: 9780072963052.
3. Ramachandran. K.P, Vijaya Raghavan. G.K, Mechatronics, A.R.S. Publications, Second Edition, 2008.
4. Bradley. D.A, Dawson. D, Burd. N.C, Loader. A.J "Mechatronics: Electronics in Products and Processes" Nelson Publisher, 2004.
5. Dan Neculescu, "Mechatronics", Pearson Education, 2005.
6. Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMRB4002	ELECTRICAL AND ELECTRONIC CERAMICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To provide in-depth knowledge about the fundamentals of various ceramic materials in electrical, electronics and energy related application.
- To prepare future materials scientist and engineers who can fit in academia and industry for relevant scientific breakthrough.
- To be well versed with fundamental theories, processing, fabrication of advanced ceramic materials for electrical, electronics and energy related applications that is adopted by industries.

**UNIT 1 STRUCTURE OF CERAMIC MATERIALS****9 Hrs.**

Introduction Brief Review of Structure in Materials, bonding in Materials, Packing of Atoms in Metals, Interstices of Covalent Ceramics, Structure of Covalent Ceramics, Ionically Bonded Ceramic Structures, Compounds based on FCC packing of Ions, Other Cubic Structures, Orthogonal Structure, Structure based on HCP packing of Ions.

**UNIT 2 DEFECT CHEMISTRY AND DEFECT EQUILIBRIA****9 Hrs.**

Point Defects, Defect Reactions, Defect Structures in Stoichiometric Oxides, Dissolution of Foreign cations in an Oxide, Concentration of Intrinsic Defects, Intrinsic and Extrinsic Defects, Units for Defect Concentration, Defect Equilibria, Defect Equilibria in Stoichiometric Oxides, Defect Equilibria in Non-Stoichiometric Oxides, Defect Equilibria in Non – Stoichiometric Oxides, Defect Structures involving Oxygen vacancies and Interstitials, Defect Equilibrium Diagram.

**UNIT 3 DIFFUSION AND CONDUCTION IN CERAMICS****9 Hrs.**

Diffusion, Diffusion Kinetics, Examples of Diffusion in Ceramics, Mobility and Diffusivity, Analogue to the Electrical Properties, Conduction in Ceramics, Ionic conduction: Basic facts, Ionic and Electronic Conductivity, Characterization of Ionic Conduction, Theory of Ionic Conduction, Conduction in glasses, Fast Ion Conductors, Nernst Equation and Application of Ionic Conductors.

**UNIT 4 DIELECTRIC CERAMICS****9 Hrs.**

Basic Properties: Dielectrics in DC Electric Field, Mechanisms of Polarization, Microscopic Approach, Determination of Local Field, Analytical Treatment of Polarizability, Effect of Alternating Field on the Behaviour of a Dielectric Material, Frequency Dependence of Dielectric properties: Resonance, Dipolar Relaxation, Circuit Representation of a Dielectric and Impedance analysis, Impedance Spectroscopy, Dielectric Breakdown, Basic Mechanisms of Breakdown.

**UNIT 5 MAGNETIC CERAMICS****9 Hrs.**

Magnetic Moments, Macroscopic view of Magnetization, Classification of Magnetization, Classification of Magnetism, Diamagnetism, Ferromagnetism, Anti ferromagnetic materials, Ferromagnetic Materials, Magnetic Losses and Frequency Dependence, Magnetic Ferrites.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Apply the theoretical knowledge imparted during course to carry out independent research and developmental work related to ceramic materials for different emerging applications.
- CO2** - To be well versed with fundamental theories, processing, fabrication of advanced ceramic materials for electrical, electronics and energy related applications that is adopted by industries.
- CO3** - Prepare future materials scientist and engineers who can fit in academia and industry for relevant scientific breakthrough.
- CO4** - Design conventional and advanced ceramics materials for future technological needs.
- CO5** - Design conventional and advanced ceramics materials for future technological needs.
- CO6** - Solve problems and case studies related to capacitor materials, electrical insulator, devices, magnetic ceramics, ceramic conducting and semiconducting materials for sensor, fuel cell, battery.

**TEXT / REFERENCE BOOKS**

1. Mohsen Mhadhbi, (2021), "Advanced Ceramic Materials", Intech Open, ISBN:9781838812041
2. A. Fletcher, (2013), "Advanced Materials 1991-1992. II. Directory", Elsevier Science, ISBN:9781483293516.
3. David W. Richerson, (2012), "The Magic of Ceramics", Wiley, ISBN:9781118392300.
4. Jose James, Pramoda Kumari Pallathadka, Sabu Thomas, (2019), "Polymers and Multicomponent Polymeric Systems Thermal, Thermo-Mechanical and Dielectric Analysis", CRC Press, ISBN:9780429943478.
5. Yet-Ming Chiang, Dunbar P. Birnie, W. David Kingery Physical Ceramics: Principles for Ceramic Science and Engineering, ISBN 9780471598732.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A : 10 Questions of 2 marks each-No choice** **20 Marks**

**PART B : 2 Questions from each unit with internal choice, each carrying 16 marks** **80 Marks**

SMRB4003	RESOURCE MANAGEMENT TECHNIQUES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To solve problems in linear programming and Integer programming.
- To develop in a student efficient and effective deployment of an organization's resources when they are needed.
- To analyze and appreciate variety of performance measures for various optimization problems.

**UNIT 1 INTRODUCTION AND LINEAR PROGRAMMING****9 Hrs.**

Operations Research(OR)- Nature – Characteristics – Phases - Role of OR in Decision making - Outline of OR Models Linear Programming – Formulation of L.P.P. problems –Solution by graphical method, simplex method, Big M methods.

**UNIT 2 TRANSPORTATION AND ASSIGNMENT MODEL****9 Hrs.**

Transportation problem – Initial Basic feasible solution- Northwest corner method, Least Cost method, Vogel's approximation method – Test for optimality-MODI method. Assignment problems- Hungarian assignment models-Travelling salesman problems.

**UNIT 3 RESOURCE SCHEDULING AND NETWORK ANALYSIS****9 Hrs.**

Problem of Sequencing – Problem with N jobs and 2 machines N Jobs 3 machines N Jobs and m machines and 2 Jobs m machines (Graphical method). Project Management -Basic concepts–Network construction and scheduling Critical Path Method (CPM) & Program evaluation review technique (PERT) and resource leveling by network techniques, time – Cost trade off.

**UNIT 4 INVENTORY CONTROL****9 Hrs.**

Inventory Control – Various Types of inventory models – deterministic inventory models – Production model, Purchase model– with and without shortage- Economic Order Quantity (EOQ) – Buffer stock – Shortage quantity, Probabilistic inventory models – Quantity Discount and Price Breaks.

**UNIT 5 QUEUEING THEORY, GAME THEORY AND REPLACEMENT MODELS****9 Hrs.**

Queueing theory – Poisson arrivals and exponential service times, Single channel models only, Concepts of Game problem. Two- person zero-sum game. Pure and Mixed strategies. Saddle point and its existence, Mixed Strategy of game theory, Concept of Dominance. Dominance and Graphical method of solving game problems. Replacement policy for items whose maintenance cost increases with time- Consideration of time value of money - Replacement policy- Individual, Group replacement of items that fail completely and suddenly.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Formulate the linear programming problems.
- CO2** - Analyze transportation and assignment problems.
- CO3** - Develop the scheduling systems and analyze CPM and PERT methods.
- CO4** - Describe the different inventory modals.
- CO5** - Design the Queuing theory and examine the replacement model.
- CO6** - Know about replacement policy, Individual and group displacement.

**TEXT / REFERENCE BOOKS**

1. K. Malik, S. K. Yadav, S. R. Yadav, Optimization Techniques. I K International Publishing House Pvt. Ltd; First Edition edition, 2013.
2. PK Gupta, D.S Hira Operations Research. S Chand seventh revised edition, 2014.
3. Sharma S.D, Operation research Theory,Methods and Application, 17th Edn., Kedar Nath Ram Nath Publication, 2010.
4. Nita H Shah, Ravi M Gor 97.
5. & Hardik Soni, Operation research, 4th Edn., PHI, 2010.
6. Edwin K. P. Chong & Stanislaw H. Zak, " An Introduction to Optimization" Wiley India, 2017.
7. Mohan, Kusum Deep, Optimization Techniques. New Age Science, 2009.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

<b>PART A</b> : 10 Questions of 2 marks each-No choice	<b>20 Marks</b>
<b>PART B</b> : 2 Questions from each unit with internal choice, each carrying 16 marks	<b>80 Marks</b>



# **SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY**

(Deemed to be university U/S 3 of UGC Act 1956)

Accredited with Grade "A++" by NAAC | 12B Status by UGC | Approved by AICTE

Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119



## **SKILL ENHANCEMENT COURSES**

SBAB4003	Entrepreneurship Essentials	L	T	P	EL	Credits	Total Marks
		1	0	0	2	1	100

### COURSE OBJECTIVES

- Develop awareness about entrepreneurship and successful entrepreneurs.
- Develop an entrepreneurial mind-set by learning key skills.
- Understand the aspects of an entrepreneur and assess their strengths and weaknesses from an entrepreneurial perspective.

**UNIT 1 :** Meaning and concept of entrepreneurship, History of entrepreneurship development, Role of entrepreneurship, Entrepreneurs, Types of entrepreneurs, Future of entrepreneurship.

**UNIT 2 :** Idea Generation, Creative and Design Thinking, Design thinking for finding solutions, The entrepreneurial decision process, Role models, Entrepreneurial success, Prototyping, Idea Evaluation, Value proposition design, Ideas development.

**UNIT 3 :** Product/Service Feasibility Analysis, Industry & competition analysis, environment analysis, financial feasibility analysis.

**UNIT4 :** Meaning and significance of a business plan, Components of a businessplan, Iterating the MVP, Digital Presence for Ventures, Clarifying the value proposition, Guidelines for writing BP, pre-requisites from the perspective of investor.

**UNIT 5 :** Translate Business Model into a Business Plan, Visioning for venture, Identify possible sources of funding for your venture – customers, friends and family, Angels, VCs, Bank Loans and key elements of raising money for a new venture, Business Licenses, business permits.

### COURSE OUTCOMES

- CO1 - Understand the fundamentals of Entrepreneurship.
- CO2 - Learn about opportunity discovery and evaluation of viable business ideas for new venture creation.
- CO3 - Start customer development, validate their ideas, and learn what prototyping is.
- CO4 - Acquire the skills and knowledge related to the various phases in venture creation process such as creating a business model and building a prototype.
- CO5 - Develop the Minimum Viable Product (MVP).
- CO6 - Create and validate a business model and business plan for their idea.

### TEXT & REFERENCES

1. Ramachandran , Entrepreneurship Development, Mc Graw Hill Katz, Entrepreneurship Small Business, Mc Graw Hill.
2. Byrd Megginson, Small Business Management an Entrepreneur's Guidebook 7<sup>th</sup> ed, Mc Graw Hill.
3. Fayolle A (2007) Entrepreneurship and new value creation. Cambridge, Cambridge University Press, Hougard S. (2005) The business idea. Berlin, Springer.
4. Lowe R & S Mariott (2006) Enterprise: Entrepreneurship & Innovation. Burlington, Butterworth Heinemann.
5. Léo-Paul Dana ,World Encyclopedia of Entrepreneurship, Edward Elgar.



SBAB4004	Innovation and Entrepreneurship	L	T	P	EL	Credits	Total Marks
		1	0	0	3	1	100

**UNIT 1 :** Start-up Opportunity recognition- The New Industrial Revolution –The Big Idea- Generate Ideas with Brainstorming- Business Start-up –Venture Choices –The Rise of The start-up Economy -The Six Forces of Change – The Start-up Equation- The Entrepreneurial Ecosystem -Entrepreneurship in India - Government Initiatives.

**UNIT 2 :** Basics of Design Thinking, Importance of Design Thinking, Design Thinking Mindset, Design thinking process, Cases of application of Design thinking approach, Executing a Design Thinking Project, Ideation process, developing and testing prototypes and writing a story of a minimum viable solution, Idea evaluation, Entrepreneurial Outlook- Value proposition design- Customer insight- Ideas development- Capstone project presentation.

**UNIT 3 :** Feasibility Analysis Product- Service Feasibility Analysis- Industry & competition analysis- Environment analysis- Financial feasibility analysis - The cost and process of raising capital – Unique funding issues of a high-tech ventures –Funding with Equity – Financing with Debt- Funding start-ups with bootstrapping- Crowdfunding- Strategic alliances.

**UNIT 4 :** Product development –Visioning for venture - Market Fit analysis - Digital and Viral Marketing – Team management - Communication- Barriers and gateways to communication - Concept of E-cells, Advantages to join E-cell- Legal and regulatory aspects for starting up specific to your venture.

**UNIT 5 :** Start-up Survival and Growth- Stages of growth in a new venture- Growing with the market – Growing within the industry- Venture life patterns- Reasons for new venture failures- Scaling Ventures – preparing for change – Leadership succession- Support for growth and sustainability of the venture - Exit options :Evaluating opportunities for acquisition; Growth financing, Scalability & efficiency improvements, IPR.

SBAB4005	INTELLECTUAL PROPERTY RIGHTS	L	T	P	EL	Credits	Total Marks
		1	0	0	3	1	100

### COURSE OBJECTIVES

- To recognize the importance of IP and to educate the students on basic concepts of Intellectual Property Rights.
- To learn the procedure of obtaining Patents, Copyrights, Trade Marks & Industrial Design.
- To promote strong IP regime and encourage innovation in order to achieve industrial and economic development goals.

### UNIT 1 : INTRODUCTION TO IPR

IPR – Types : Patent, Copyright, Trade mark, Design – Geographical indications – Trade secrets – IPR in India: Case Study.

### UNIT 2 : TRADEMARK

Trademark-Definition - Type – Registration - Trademark infringement –Case Study.

### UNIT 3 : COPYRIGHT

Copyright – Definition and subject matter - Copyright and related rights - Copyright registration and entrepreneurship - Copyright infringement – Case study.

### UNIT 4 : PATENT

Patent: Introduction – Historical development - Definition – Types – Patent Rights - Inventiveness/Non-obviousness – Novelty, Utility - Law and Practices.

### UNIT 5 : DESIGN

Design – Meaning and Concepts of novel and original – Procedure for Registration – Effect and Terms of Registration – Promoting IPR – Government Schemes in IPR.

On successful completion of this course the student should be able to:

- CO1 - Distinguish and Explain various forms of IPRs.
- CO2 - Identify criteria's to fit one's own intellectual work in particular form of IPRs.
- CO3 - Apply statutory provisions to protect particular form of IPRs.
- CO4 - Analyse rights and responsibilities of holder of Patent, Copyright, Trademark, Industrial Design etc.
- CO5 - Identify procedure to protect different forms of IPRs national and international level.
- CO6 - Develop skill of making search using modern tools and technics.

### REFERENCES

1. Dr.G.B Reddy, "Intellectual Property Rights and Law", Gogia Law Agency,Hydrabad,Reprint edition, 2020.
2. N.R. Subbaram.S.Viswanathan, "Hand book Indian Patent Law and, Practice" Printers and publishers Pvt, Ltd, 2008.
3. Cornish, "Intellectual Property Rights", Universal publications, 2011.
4. Dr.B.L.Wadehra, "Law Relating to Intellectual Property" 5th edition, Universal Law publishing Co, Delhi, 2016.

SPCB4005	COMMUNICATIVE IN ENGLISH	L	T	P	EL	Credits	Total Marks
		1	0	0	2	1	100

**UNIT 1 :** Goal Setting Emotional Quotient Habit formation, this enhances Behavioural, Managerial and Entrepreneurial skill sets which is mandatory to thrive in any field. Helps boost EQ (Emotional Quotient), Theatre, to make students speak on stage in pairs. Scenarios are given and pairs of students take roles and converse in English on the stage.

**UNIT 2 :** Email & Report Writing, This session provides an orientation on email Dos and Don'ts, basics of email correspondence as well as tips to write effective emails. Students begin practicing emails followed by feedback. LinkedIn Profile Building, LinkedIn is now the default global professional network. Students will gain insights into using LinkedIn to build a network, search for job/internship via Easy Apply & Company ATS, Writing Essentials, Paragraph writing, Essay Writing Workshop – 1.

**UNIT 3 :** Insane Inventor, To make students present a creative idea or a product on the stage. This is an individual task-based presentation session. This helps students instigate innovation and creative thinking along with presentation skills.

**UNIT 4 :** Motivation, Critical Thinking(Rebus puzzle), Impression Management/Leadership, Team Building, This enhances Behavioural, Managerial and Entrepreneurial skill sets which is mandatory to thrive in any field. Helps boost EQ (Emotional Quotient).

**UNIT 5 :** Reading comprehension, a. Speed Reading Strategies, b. RC - Types and Tackling Strategies Sentence correction, a. Subject-Verb Agreement, b. Modifiers, c. Parallelism, d. Pronoun-Antecedent Agreement, e. Verb Time Sequences, f. Comparisons, g. Prepositions, h. Determiners.

SPCB1401	Problem Solving & Behavioural Skills Development	L	T	P	EL	Credits	Total Marks
		1	0	0	3	1	100

**UNIT 1** : Number system, a. Number system, b. Power cycle, c. Remainder cycle, d. Factors, Multiples e. HCF and LCM, Reading comprehension, a. Speed Reading Strategies, b. RC - Types and Tackling Strategies, Data arrangements and Blood relations, a. Linear Arrangement, b. Circular Arrangement c. Multi-dimensional Arrangement, d. Blood Relations Time, Speed and Distance, a. Basics of time, speed and distance, b. Relative speed, c. Problems based on trains, d. Problems based on boats and streams, e. Problems based on races, Articles, Prepositions and Interrogatives, a. Definite and Indefinite Articles, b. Omission of Articles, c. Prepositions, d. Compound Prepositions and Prepositional Phrases, e. Interrogatives, Ratio and Proportion, a. Ratio, b. Proportion, c. Variation, d. Simple equations, e. Problems on Ages.

**UNIT 2** : Logical connectives, Syllogism and Venn diagrams, a. Logical Connectives, b. Syllogisms c. Venn Diagrams – Interpretation, d. Venn Diagrams – Solving: Logarithms, Progressions, Geometry and Quadratic equations, a. Logarithm, b. Arithmetic Progression, c. Geometric Progression, d. Geometry, e. Mensuration, f. Quadratic Equations, Attention to detail, a. String matching, b. Text and image comprehension Qs, c. Decision based Qs.

**UNIT 3** : Image Interpretation, a. Rebus puzzles, b. Forming words based on images, Clocks, calendars, Direction sense and Cubes, a. Clocks, b. Calendars, c. Direction Sense d. Cubes, Voices and Speech, a. Active Voice and Passive Voice b. Direct Speech and Indirect Speech.

**UNIT 4** : Critical reasoning, a. Argument – Identifying the Different Parts (Premise, assumption, conclusion), b. Types of Questions, Algebraic Expressions, a. Remainder of an expression, b. Factors, multiples, HCF and LCM of expressions, c. Finding maxima and minima, Surds, Indices and Simplification, a. Surds, b. Indices, c. Simplification exercises.

**UNIT 5** : Set Theory, a. Set definition and formulas, b. Power set, c. Sub set, d. Set multiplication, Functions, a. Roots of a function, b. Domain and range, c. Problems involving multiple functions, Cryptarithmic, Trigonometry, a. Heights and distance problems, b. Identities, angles, c. Simplification.

SPCB1501	Computer Programming for IT Services	L	T	P	EL	Credits	Total Marks
		1	0	0	3	1	100

**UNIT 1** : Introduction to Programming, History, Features, Path Setting, JDK, JRE and JVM, Internal details of JVM, Compilation, Working with IO & Operators, IO & Operators.

**UNIT 2** : Decision Making, Need of Decision Making, Syntax, Examples for Decision Making, Hands – on, Input – Output, Working with Operators.

**UNIT 3** : Iterations, For, While, Do-while, Pattern Programming, Hands – on, Decision Making, Working with Arrays, 1D, Accessing arrays, Manipulating Arrays, ID, Hands – on, Iterations, Accessing arrays.

**UNIT 4** : Manipulating Arrays, 2D, Series Programming, Pattern Programming, Recursion, Static Keyword, Arrays - 1D, String, String API.

**UNIT 5** : Command Line arguments, File Handling, File Handling.

SPCB1601	Advanced Programming – Product Developer	L	T	P	EL	Credits	Total Marks
		1	0	0	2	1	100

**UNIT 1** : Time, Speed and Distance, a. Basics of time, speed and distance, b. Relative speed, c. Problems based on trains, d. Problems based on boats and streams, e. Problems based on races, Articles, Prepositions and Interrogatives, a. Definite and Indefinite Articles, b. Omission of Articles, c. Prepositions, d. Compound Prepositions and Prepositional Phrases, e. Interrogatives, Ratio and Proportion, a. Ratio, b. Proportion, c. Variation, d. Simple equations, e. Problems on Ages, Logical connectives, Syllogism and Venn diagrams, a. Logical Connectives, b. Syllogisms, c. Venn Diagrams – Interpretation, d. Venn Diagrams – Solving.

**UNIT 2** : Logarithms, Progressions, Geometry and Quadratic equations, a. Logarithm, b. Arithmetic Progression, c. Geometric Progression, d. Geometry, e. Mensuration, f. Quadratic Equations, Attention to detail, a. String matching, b. Text and image comprehension Qs, c. Decision based Qs, Image Interpretation, a. Rebus puzzles, b. Forming words based on images, Clocks, calendars, Direction sense and Cubes, a. Clocks, b. Calendars, c. Direction Sense, d. Cubes.

**UNIT 3** : Voices and Speech, a. Active Voice and Passive Voice b. Direct Speech and Indirect Speech, Critical reasoning, a. Argument – Identifying the Different Parts (Premise, assumption, conclusion), b. Types of Questions.

**UNIT 4** : Algebraic Expressions, a. Remainder of an expression, b. Factors, multiples, HCF and LCM of expressions, c. Finding maxima and minima, Surds, Indices and Simplification, a. Surds, b. Indices, c. Simplification exercises, Set Theory, a. Set definition and formulas, b. Power set, c. Sub set, d. Set multiplication.

**UNIT 5** : Functions, a. Roots of a function, b. Domain and range, c. Problems involving multiple functions, Cryptarithmic, Trigonometry, a. Heights and distance problems, b. Identities, angles, c. Simplification.

SPCB1604	Advanced Core Engineering	L	T	P	EL	Credits	Total Marks
		1	0	0	3	1	100

**UNIT 1 :** Linked List, Print the Elements of a Linked List, Insert a Node at the Tail of a Linked List, Insert a node at the head of a linked list, Insert a node at a specific position in a linked list, Linked List, Delete a Node, Print in Reverse, Reverse a linked list, Compare two linked lists, Merge two sorted linked lists.

**UNIT 2 :** Hands-on, Linked List, Stacks, Linked List Implementation & Array Implementation, Function Calls - Maximum Element, Balanced Brackets, Queues, Implementation of Queue, Queue using Two Stacks, Castle on the Grid.

**UNIT 3 :** Hands-on, Stacks, Queues, Binary Tree & Binary Search Tree, BST - Insertion, Tree Traversals –In order, Pre order, Post order, Level order traversal, Binary Tree & Binary Search Tree, Height of Binary Tree, Tree - Top view, BST - Lowest Common Ancestor, Self Balancing Tree, Swap nodes.

**UNIT 4 :** Hands-on, Binary Tree & Binary Search Tree, Hashing, Open hashing and Closed hashing, Heaps, Min and Max heap, Applications of heaps, Hands-on, Hashing, Hands-on, Heaps, Searching, Linear, Binary, Ternary and Jump search, Sorting, Bubble, Insertion, Selection sort, Quick and Merge, Hands-on, Searching.

**UNIT 5 :** Hands-on, Sorting, Naïve, KMP, Rabin-Karp, Z algorithm, Manachars algorithm Hands-on, String Algorithms, Recursion, Staircase problem, optimal problem, Robot path Permutation and Combination, Permutation, Combination with particular sum, Recursion, Permutation and Combination, Rat in a maze, N queen problem, Backtracking, Flood fill algorithms, coloring problem, Hands-on Backtracking.