VIGNAN'S

Foundation for Science, Technology & Research

(Deemed to be **UNIVERSITY**)

-Estd. u/s 3 of UGC Act 1956

R22 **Minor Streams**

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PREFACE

In our childhood Playing Complemented Studying, and it was Playing which made us to understand the importance of Studying. Playing always rediscovered a new enthusiasm for Studying. If Studying could be considered as MAJOR, playing performed the role of a MINOR. In fact, MINOR played a MAJOR role in making us to be studious with the MAJOR. Playing and Studying together made the learning holistic.

At higher level, one need to specialize in a discipline. If this area of specialization could be termed as MAJOR, then that would be the focus of one's higher education. However, the study of MAJOR will be holistic if and only if it is complementing with a supporting field of study called MINOR, which creates a silver lining for the MAJOR that provides an edge of advantage for the leaner.

The appropriate pairing of MINOR course of study with MAJOR discipline would enhance the value of holistic learning and it would result in a vibrant vibe. It simply creates an additional dimensional scope in every aspect in future life – could that be while seeking employment, or while going for higher studies including research studies, or while navigating through professional life, or at least as a source of additional knowledge.

One can always choose, one of the available baskets of MINOR streams or one can always create his own basket which can be his own hoard. In R22, the first option is conventionally identified as MINOR stream and second one leads to ADD-ON DIPLOMA, a self-designed MINOR.

A wide variety of baskets for MINOR streams are made available in VIGNAN, potentially because VIGNAN is a multi-disciplinary University. Many more baskets would also be devised. The possibilities cut across varied disciplines of learning – Engineering and Non-engineering. Exercising the right choice, either pursuing the MINOR field of study or specializing in the MAJOR field itself, should be based on what provides you the pleasure and creates a pleasant scope for your future.

Sure, you should receive the suggestions and you should get counselled in this regard, however the decision should be yours, of which you will be proud in your future life.

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List of R22 Minors Streams offered in R22 regulations

Sl. No	Minor Courses - Streams	Offered By	Page Number
1	Smart Farming : The Future of Agriculture	Agriculture & Horticulture Sciences	
2	Forensic Genomics	Bioinformatics	
3	Biomedical Instrumentation	Biomedical Engineering	
4	Community Health	Biotechnology	
5	Environmental Management & Technology	Civil Engineering	
6	Geospatial Data Science & Technology	Civil Engineering	
7	Smart Technologies in Engineering	Civil Engineering	
8	Artificial Intelligence & Machine Learning	Computer Science Engineering	
9	Computer Science	Computer Science Engineering	
10	Cyber Security	Computer Science Engineering	
11	Data Science	Computer Science Engineering	
12	Embedded Systems and IoT	Electronics & Communications Engineering	
13	Alternate Energy Technologies	Electrical & Electronics Engineering	
14	Electrical Mobility	Electrical & Electronics Engineering	
15	Food Processing Technology	Food Technology	
16	Cyber Law, IPR & Constutional Laws	Vignan Institute of Law	
17	Engineering Management	Management studies	
18	Entrepreneurship & IPR	Management studies	
19	Event Management	Management studies	
20	Reliability Engineering	Mechanical Engineering	
21	Unmanned Aerial Vehicles	Mechanical Engineering	
22	NCC	NCC (National Cadet Corps)	
23	Robotics Engineering	Robotics & Automation	
24	Humanities and Social Sciences	Training & Placement	
25	Practices in Computing	Training & Placement	
26	Ways of Wellbeing	Student Affairs & Physical Education	
27	Photography & Digital Film Making	Student Affairs & Physical Education	

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MINOR ON SMART FARMING: THE FUTURE OF AGRICULTURE
Offered by Department of Agricultural & Horticultural Sciences

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The technologies embraced under the theme of 'Smart farming' revolutionize the practices in agriculture opening ample opportunities in the field of agriculture. In fact, the increasing global population pose a challenge of food security and indeed there is a need to bring innovations for sustainable food production with less impact on climate change. Smart farming has drawn the attention of stakeholders to stimulate much more innovations in this field.

Can farming in this technological era become smart?

Through the implementation of GIS, GPS, Remote sensing and Drone technologies in agriculture and Nanotechnology techniques brings in several benefits of precision farming over conventional farming strategies. Some of these include increased control over production processes, which in turn enhances cost management and reduce agricultural waste. In addition to this, smart farming, in agriculture, makes it easier to trace disparities in crop growth by abiotic and biotic causes.

What is Agriculture Business Management?

Agriculture business management specifically focus on the business aspects of agriculture production and international trade. It assists the agricultural sector, providing professionals and business leaders. This course focuses on aspects of Agricultural production management and supply chain management such as making key business decisions and minimizing risk.

Is Hi-Tech horticulture and Soil less farming advantageous over traditional farming?

This hi-tech horticulture technology and smart farming offers several advantages over traditional production techniques such as in greenhouse cultivation, horticultural products mainly fruits, vegetables and flowers can be produced under protected cultivation even during their off seasons. Hydroponics and Aeroponics are other hi-tech horticulture technologies that offer great scope for horticultural and Agricultural producers worldwide. It is also known as soilless cultivation helps the producers to grow plants in nutrient solution, without using the standard soil medium.

Digital agriculture: A lane to prosperity in agriculture?

This Digital agriculture course is the use of new and advanced technologies, integrated into one unit that enable farmers and other stakeholders within the agriculture value chain to improve food production marketing, and profitability by using ICT, IoTs and several other digital technologies.

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"Smart Farming is the Future of Agriculture"

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Choosing the minor is an opportunity for the engineering students providing a scope to become Agri-entrepreneurs and also can become job providers than job seekers.

Course Code	Course Title	L	T	P	C
22AH901	Basics of crop production and precision farming	2	0	4	4
22AH902	Hi-tech Horticulture	2	0	4	4
22AH903	Agribusiness Management	2	0	4	4
22AH904	Soilless Farming (Hydroponics, Aeroponics and Aquaponics)	2	0	4	4
22AH905	Digital Agriculture	2	0	4	4
22AH906	Capestone Project	0	2	4	4

22AH 901 - BASICS OF CROP PRODUCTION AND PRECISION FARMING

	Hours per week:		
L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Intermediate or Equivalent.

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the basics of crop production and the principles of precision agriculture.

MODULE-1

UNIT-1 8L+0T+0P=8 Hours

BASIC PROPERTIES AND PROBLEMS OF SOIL:

Soil physical properties: Soil-texture, structure, density and porosity, Soil colour, consistence and plasticity; Soils of India; Soil water retention, movement and availability; Soil temperature and plant growth; Soil pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; Soil EC, Soil organic matter: composition, properties and its influence on soil properties; soil organisms: macro and microorganisms, their beneficial and harmful effects; Soil Pollution – Definition, Types, Causes and Effects; Crop growth and development; Soil plant water relationship; Mineral nutrition of Plants - Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms.

UNIT-2 8L+0T+32P=40 Hours

CROP PRODUCTION MANAGEMENT AND ITS APPLICATIONS:

Fundamentals of Agronomic practices; Tillage – Types of tillage, Seeds – Seed rate, methods of sowing, importance of time and depth of sowing, Nutrient management – Methods to improve NUE (Nutrient Use Efficiency), Fertilizer recommendations for different crops, Physical classification of water, Critical stages of irrigation in crops, Water management – Irrigation and its importance; Irrigation methods – Surface, subsurface and micro irrigation methods; Weed management – Weeds, beneficial and harmful effects of weeds, classification of weeds, methods of weed management – Physical, mechanical, chemical and biological methods of weed control – Harvesting – Methods of harvesting, Post-harvest operations – Threshing, winnowing, drying, storage - Yield attributes.

PRACTICES:

- Identification, classification of crops and agronomic characters of cereal, pulse, millet crop varieties.
- Identification and Practice of primary, secondary tillage, and sowing implements.
- Practice of fertilizer application (basal, top dressing, soil and foliar application of nutrients and fertigation).
- Identification of weeds and practice of weed control methods.
- Types of Irrigation and Water Use Efficiency (WUE).
- Study of growth stages / morphological description of different crops.
- Study of yield attributes, harvesting symptoms and estimation of yield.
- Determination of soil texture by bouyoucos hydrometer and field method.
- Estimation of soil pH and EC.
- Crop growth analysis.
- Diagnosis of nutrient deficiency symptoms in crops.

MODULE-2

UNIT-1   **8L+0T+0P=08 Hours**
INTRODUCTION TO PRECISION AGRICULTURE AND NANOTECHNOLOGY:
Precision agriculture – Concept, and techniques – Principles and practices of precision agriculture, Issues and concerns for Indian agriculture; Geological Information System (GIS), Global Positioning System (GPS), Remote sensing – Components. Nanotechnology, definition, concepts and techniques – Nano scale – definition – Nanoparticles and materials - Occurrence – Properties; Nano sensors; Nano-fertilizers, Nano-pesticides - Importance and advantages.

UNIT-2   **8L+0T+32P=40 Hours**
APPLICATIONS OF PRECISION AGRICULTURE AND NANOTECHNOLOGY:
Crop discrimination and yield monitoring techniques; Application of GIS, GPS, and remote sensing techniques in agriculture; Characterization of Nano materials – Structural characterization – Nano sensors; Nano-fertilizers, Nano-pesticides – Synthesis – Strategies; Application of nanotechnology in agriculture – Tillage, seed, water, fertilizers, plant protection for scaling-up farm productivity; Soil mapping techniques, Image processing and interpretation; STCR (Soil Test Crop Response) approach and computations for precision agriculture; Spectral reflectance of various earth features, atmospheric windows; Applications of remote sensing techniques in the field of agriculture and allied sciences including drones, spatial variability of soil fertility and its determination, fertilizer recommendation using geospatial technologies in precision farming.

PRACTICES:
- Visual and digital interpretation of remote sensing images.
- Generation of spectral profiles of different objects.
- Supervised and unsupervised classification and acreage estimation.
- Multispectral remote sensing for soil mapping.
- Creation of productivity and management zones.
- Fertilizers recommendations based on VRT (Variable Rate Technology) and STCR techniques.
- Formulation, characterization of nanoparticles.
- Applications of nanoparticles in agriculture.
- Projects formulation and execution related to precision farming.

SKILLS:
- ➢ Develop profitable crop production technologies.
- ➢ Application of GIS, GPS, and Remote sensing technology to practice precision farming.
- ➢ Application of nanotechnology to practice precision farming.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1.	Application of Crop production knowledge for precision farming.	Apply	1	1,2

2.	Application of GIS & GPS and remote sensing including drones and their use in mapping and monitoring crop variability and their performance.	Apply	2	3,11
3.	Distinguish the variations in agricultural fields and analyze the suitable techniques to identify problems in agricultural fields.	Analyse	2	3
4.	Evaluate nanotechnology and targeted use of water, fertilizer, agrochemicals, and other inputs for more efficient and profitable agriculture.	Evaluate	2	3,5

TEXTBOOKS:
1. Reddy S.R, "Geo-informatics and Nano Technology for Precision Farming". Kalyani Publishers, 2020.
2. Tarun Kumar U and Sushil Kumar S, Textbook on Geo-informatics, Nanotechnology and Precision Farming. New Delhi Publishers, 2020.

REFERENCE BOOKS:
1. Pradeep T, "NANO: The Essentials: Understanding Nanoscience and Nanotechnology". Tata McGraw-Hill Publishing Company Limited, 2017.
2. Lilles T.M, and Kiefer R.W, "Remote sensing and image interpretation", John Wiley and Sons 3rd Edition update 2011.
3. Anji Reddy M, "Textbook of Remote Sensing and Geographical Information Systems", 3rd Edition, B.S. Publications, 2006.
4. Chandra A.M, "Geo-Informatics". New Age International 1st Edition, 2006.

https://www.agrifac.com/sustainable-farming/precision-farming/

22AH903 - HI-TECH. HORTICULTURE

Hours per week:

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Intermediate or Equivalent.

COURSE DESCRIPTION AND OBJECTIVES:
Main objective of this subject is to introduce the students about latest technology in the field of horticulture.

MODULE-1

UNIT-1   8L+0T+0P=08 Hours
BASICS OF PROTECTED CULTIVATION:
Introduction and importance of nursery management and mechanization; micropropagation in horticultural crops; Modern field preparation and planting methods; Protected cultivation – prospects - techniques – advantages; types of protected structures – greenhouse, polyhouse, shade net houses, rain shelters etc., Designing and erection of protected structures. Government schemes for promotion of Hi-Tech. Horticulture.

UNIT-2   8L+0T+32P=40 Hours
GREENHOUSE STRUCTURES AND MANAGEMENT:
Low cost/Medium cost/ High-cost Structures – economics of cultivation; Location specific designs; Structural Components; Environment control – management and manipulation of temperature, light, humidity, air and CO_2; Heating and cooling systems, ventilation, naturally ventilated greenhouse – fan and pad cooled greenhouses, light regulation. Micro irrigation systems, and components of micro-irrigation systems.

PRACTICES:
- Shade net houses.
- Estimation of pH in soil and water.
- Intercultural operations.
- Mulching in horticultural crops.
- Identification and application of tools and equipment.
- Media used in greenhouses.
- Cost of production under greenhouse cultivation.
- Nursery raising in portrays.
- Hardening plants in the nursery.
- Irrigation and fertigation techniques in greenhouses.
- Study of Micro-irrigation system and its components (sprinkler irrigation, drip irrigation, sub-surface irrigation).
- Problems of micro irrigation system.
- Micro propagation (Tissue culture techniques in horticultural crops).
- Tissue culture techniques in banana.
- Estimation of EC of soil and water.

MODULE-2

UNIT-1   **8L+0T+0P=8 Hours**

NUTRITION IN PROTECTED CULTIVATION AND CANOPY MANAGEMENT:
EC, pH-based fertilizer scheduling – concept, nutrition requirement for greenhouse cultivation of important flower crops and vegetables; Integrated Nutrient Management; Canopy management in fruit crops; high density planting and its components; Problems of cultivation under greenhouse condition.

UNIT-2   **8L+0T+32P=40 Hours**

PRECISION HORTICULTURE AND POST-HARVEST DRYING TECHNIQUES IN HORTICULTURAL CROPS:
Precision Horticulture techniques: GIS, GPS and Remote sensing. High density planting; Drying and dehydration – Moisture measurement – Equilibrium Moisture Content - Drying theory - Various drying methods - Commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, re-circulatory dryer, and solar dryer).

PRACTICES:
- Fertilizer scheduling.
- High density planting in fruits.
- Canopy management in Mango.
- Canopy management in Guava.
- Canopy management in Grapes.
- Components of precision horticulture.
- Study of equipment used in dehydration.
- Study of pre-treatments for dehydration.
- Different drying techniques.
- Preparation of dried/dehydrated products.
- Evaluation of different methods of drying.
- Quality of dehydrated products.
- Visit to Hi-Tech. orchard and Hi-Tech. nursery.
- Visit to drying / dehydration units.

SKILLS:
- Handling of different equipment used in poly-houses and nurseries.
- Canopy management and high-density planting in horticultural crops.
- Expertise in different grafting and micro propagation techniques.
- Application of Geographical Information System (GIS), Differential Geo-Positioning System (DGPS), Variable Rate applicator (VRA) in precision farming in horticultural crops.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1.	Illustrate the nursery management and mechanisms; and micro-propagation of horticultural crops.	Analyze	1	3

| 2. | Use the components of protected cultivation. | Apply | 2 | 3 |
| 3. | Adopt the knowledge of modern field preparations and planting methods in protected cultivation. | Apply | 2 | 10 |

TEXTBOOKS:
1. Prasad. S and Kumar U, "Greenhouse Management of Horticultural Crops". Agribios publishers, 2nd Edition 2012.
2. Srivasthava. K.K, "Canopy Management of Fruit Crops", International book distributing co., 2007.

REFERENCE BOOKS:
1. Elhadi Yahia, "Postharvest Technology of Perishable Horticultural Commodities" Woodhead Publishing, 2019.
2. Sahu. K.C, "Textbook of Remote Sensing and Geographical Information Systems". Atlantic publishers & Distributors, 2022.
3. Srivastava, "Fruit and Vegetable Preservation Principles and Practices Revised and Enlarged", CBS Publishers, 3rd Edition, 2019.
4. Singh H.P, Singh G, Samuel J.C and Pathak R.K, "Precision Farming in Horticulture", NCPAH, MOA, PFDC, CISH, 2013.
5. Singh J, Jain S.K and Dashora, L.K, "Precision Farming In Horticulture". NIPA Publishers, 2013.

https://www.futurefoodsystems.com.au/hort-innovation-set-to-bring-high-tech-horticulture-to-australias-cities/

Hours per week:

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Intermediate or Equivalent.
COURSE DESCRIPTION AND OBJECTIVES:
Main objective is to familiarize the students about the agribusiness management which enables them to set commercial agribusiness of big farms.

MODULE-1

UNIT-1   **8L+0T+0P=8 Hours**
INTRODUCTION TO AGRIBUSINESS MANAGEMENT:
Introduction to Agribusiness Management, Agribusiness – Definition, Profile, and Scope; Different Terms and Concepts of Agribusiness, Importance, and its role in the Indian Economy; Updates of Economic Survey presented to parliament every year; Management – Definition, Nature, Scope, and Importance; Evolution of Management thought; Scientific management – Elements, and Principles; Nature, Scope, and concept of Operations Management.

UNIT-2   **8L+0T+32P=40 Hours**
MANAGEMENT THEORY AND PRODUCT MANAGEMENT:
Functions of management, Levels of managers, Line, and staff managers; Modern operational management theory; Operations in manufacturing and service industries, Facility location, Product, and process design.

PRACTICES:
- Identification of facility location for any agro product in the state of Andhra Pradesh.
- Conducting a farmer survey on Product (manufacturing product) features of any agri input (understanding product design).
- Conducting a market study on process design for any service offered to farmers.
- Market environment analysis for any one agri product.
- Identification of market mix for any popular agri product
- Plotting of various agro based products on product life cycle stages.
- Activity on collection of innovative promotion strategies/materials/tools for 5 agri products.
- Analyzing pricing strategies followed for various agro based products.
- Collection of 5 innovative packing materials each by students, used for packing agri and food products, classroom display and discussion.
- Compounding and discounting techniques.
- Financial ratio analysis.

MODULE-2

UNIT-1   **8L+0T+0P=8 Hours**
MARKETING MANAGEMENT:
Concept of Marketing Management – Production concept – Product concept – Selling concept – Marketing concept; The market environment. Marketing mix variables – 4 P's of marketing; 7 P's of Agriculture services marketing and alliances; Interaction between marketing mix and environmental variables; Market segmentation and targeting marketing mix and market segmentation; Product life cycle (PLC) and competitive strategies: Meaning and stages in PLC, characteristics of PLC, strategies in different stages of PLC; Project appraisal techniques, SWOT analysis, appraisal and evaluation techniques, sensitivity analysis. basic guidelines for preparation of project reports. Agribusiness Projects Evaluation – concepts, project cycle, entrepreneurship,

significance of entrepreneurship in economic development, qualities of entrepreneur, entrepreneurial functions, skills and its role, entrepreneur vs. entrepreneurship.

UNIT-2   **8L+0T+32P=40 Hours**
PROJECT MANAGEMENT:
Pricing and promotion strategies: pricing considerations and approaches – cost based and competition-based pricing; Market promotion – advertising, personal selling, sales promotion, and publicity – their meaning, and merits & demerits; Visit & Study of Profile of Agro-based industries, Formulation of project, feasibility report of agribusiness enterprise; Role of various institutions in developing agribusiness entrepreneurship; (Small Industries Development Corporation (SIDO), National Small Industries Corporation (NSIC), Khadi & Village Industries Commission (KVIC), District Industries Center (DIC), National Institute of Small Industry Extension Training (NISIET) etc. Identification of Business Opportunities and guidelines for starting Farm Enterprises, Business plan preparation, Business incubation terminologies.

PRACTICES:
- Techno-economic analysis for any agri project.
- SWOT analysis for any project.
- Balance sheet analysis.
- Analysis of profit and loss statement.
- Break even analysis / Cost volume profit analysis.
- Development of business performance tracking system.
- Project appraisal techniques – I Undiscounted measures –PBP (Pay Back Period), ROR (Rate of Return).
- Project appraisal techniques – II Discounted measures NPV (Net Present Value), BCR (Benefit-cost Ratio).
- Project appraisal techniques – III – IRR (Internal Rate of Return), N/K Ratio (Net Benefit Investment Ratio) & PI (Profitability Index) and sensitivity analysis.
- Project report preparation for any agri product.
- Preparing business plans.
- Visit and study profile of agro based industries.
- Formulation of project feasibility report of agribusiness enterprise.

SKILLS:
- Improve entrepreneurial skills.
- Prepare business plans for agro-based industries.
- Prepare balance sheet to prepare business plans.
- Plan for different entrepreneurial strategies.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to

| CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1.	Apply knowledge of agribusiness management in Indian economy, management structure and definitions, capital management and financial management.	Apply	1	9, 10
2.	Analyse the structure and operation of local, regional, and international agricultural markets, trade agreements, quality control methods and standards employed.	Analyse	1	2, 4

3.	Comprehend knowledge about public and private sector marketing institutions and the role of Government in regulating markets and fixing prices.	Apply	2	2, 4	
4.	Integrate knowledge acquired on types of agro-based industries, different marketing systems, different pricing systems in setting up of an agro based industry.	Apply	2	2, 4, 10	
5.	Balance sheets, profit, and loss statements Applications.	Apply	2	9, 10	
6.	Better understand the production risks and risk covering mechanisms, natural resource economics and be able to initiate start-up businesses on his own or support initiatives by others.	Analyse	2	9, 10	

TEXTBOOKS:
1. Kotler P and Kevin LK, "Marketing Management", Prentice Hall of India Private Ltd., 2015.
2. Stevenson WJ, "Operations Management", Tata McGraw Hill, 14th Edition, 2021.

REFERENCE BOOKS:
1. Robbins SP, "Organizational Behaviour", Prentice Hall of India Private Limited, 2016.
2. Chandra P, "Project Management". Tata McGraw Hill, 2017.
3. Vasant Desai, "Dynamics of Entrepreneurship Development", Himalaya Publishers, 6th Revised Edition, 2016.
4. Chandra P, "Financial Management - Theory and Practice". Tata Mc Graw Hill Publishing Company Ltd., 10th Edition update, 2019.
5. Mukesh P and Deepali T, "The Agri Business Book", IBDC Publishers, 2010.

https://www.tasagjobs.com.au/2020/11/17/agribusiness-management-career/
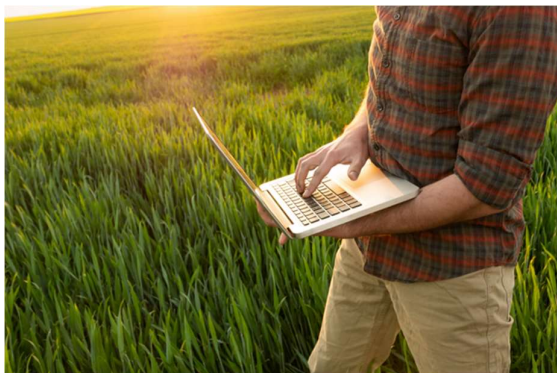
22AH904 – SOIL-LESS FARMING

Hours per week:

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Intermediate or Equivalent.

COURSE DESCRIPTION AND OBJECTIVES:
Main objective of this subject is to impart knowledge about Soil-less farming (Hydroponics, Aeroponics and Aquaponics).

MODULE-1

UNIT-1   **8L+0T+0P=8 Hours**
INTRODUCTION TO HYDROPONICS:
Introduction and history of Hydroponics, Aeroponics and Aquaponics; Hydroponics system and its working; Advantages and disadvantages of Hydroponics; Types of aeroponics – single bucket system – multi bucket system –Aeroponics in agriculture (vertical farming) - benefits and drawbacks – aeroponics in space – benefits; Aquaponics – methods and types of aquaponics – types of fish to grow and their management – use of bacteria to avoid contamination; Materials used and nutrient solutions: growing media or support materials (substrates) description.

UNIT-2   **8L+0T+32P=40 Hours**
PRINCIPLES AND MANAGEMENT PRACTICES IN HYDROPONIC CULTURE:
Nutrient solutions; Types of hydroponic systems, Hydroponics with substrate, real hydroponics without substrate, Closed cycle, Open cycle, Sand culture, types of sand culture techniques (Wicking, ebb and flow, drip etc.); Solution culture and its techniques, Static or passive systems (wick system, deep water culture / floating raft etc.,), Active or dynamic systems (ebb & flow, bubbles, Nutrient Film Technique: NFT), Types of NFT.

PRACTICES:
- Introduction to hydroponic technology, hydroponic growing systems, Basic Concepts and Designs, Site considerations.
- Plant growth requirements – light, artificial light – light balancers, temperature.
- Plant growth requirements – nutrition, nutrient requirements, deficiencies, toxicities, pH, EC, salinity, TDS growth regulators, oxygen level.
- Growing media – Types, Properties, Uses.
- Hydroponic nutrient solutions - Types, Nutrient formulae / Composition, Preparing solutions.
- Hydroponic equipment – componentry, nutrient delivery, pumping and testing.
- Growing structures – types, design, and construction.
- Environmental control – heating, cooling, lighting, shading, CO2 enrichment.
- Plant culture in hydroponics– raising seedlings, nursery keeping and management, Transplanting, trellising, pruning.
- Irrigation – soil requirements, irrigation systems, irrigation, and fertigation management.
- Setting up of hydroponic systems and sand culture systems.
- The design and set up of nutrient film technique hydroponic system (Flatbed NFT, 'A' Frame – 54, 'A Frame' – 154, Drip bucket system / Kratky method).
- Deep flow technique for hydroponic crop production.

MODULE-2

UNIT-1   **8L+0T+0P=8 Hours**

ADVANCED HYDROPONIC SYSTEMS AND HYDROPONIC NUTRIENT SOLUTIONS:
Advanced hydroponic systems - deep water culture, Kratky method, Dutch bucket system; Materials used and nutrient solutions: growing media or support materials (substrates) – description, nutrient solutions - inorganic hydroponic solutions- organic hydroponic solutions – additives - aeration of solutions – EC, pH, TDS and oxygenation level adjustment.

UNIT-2   **8L+0T+32P=40 Hours**

GREENHOUSE STRUCTURES AND SOFTWARES FOR HYDROPONICS
System requirements: Hydroponic greenhouse & its components - different models of structures for hydroponic system - lighting, temperature and environmental control - laboratory glass ware, tools and equipment – green house control systems and automation - software – the free and open-source tools – HydroBuddy and HydroCal, how to choose the right system, applications of hydroponics in agriculture (roof top gardens, vertical gardens, living walls, vertical farming etc) and in research.

PRACTICES:
- pH, EC and TDS monitoring in hydroponic systems.
- Setting up a Dutch bucket / Bato bucket hydroponic system.
- Setting up a Dutch bucket deep water hydroponic system.
- Monitoring water level in hydroponic systems and oxygenation level in hydroponic nutrient solutions.
- Setting up of aeroponic vertical towers and aquaponic system.
- Monitoring periodic plant health – Physiological alterations, weeds, pests and diseases.
- Treating algae problems in Dutch bucket hydroponic systems.
- Management of root associated problems in hydroponic cultivation.
- Commercial hydroponics farm set up.
- Managing a commercial hydroponic farm – crop scheduling and selection standards.
- Hydroponic systems cleaning – green house hygiene management.
- Practical tips for optimal management of hydroponic cultivation – management, organization, supervision, daily maintenance.
- Harvest procedures, post-harvest grading, sorting and packing, marketing – promotion and selling. Economics of hydroponic farming.
- Advanced sensor technology to monitor water pH levels in real time, air speed, CO_2 levels, Humidity. light, temperature, oxygen and plant health.
- Software tools for automation in hydroponic system.

SKILLS:
- Preparation of Media for Hydroponics.
- Expertise in different soil-less farming techniques.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1.	Explain the basic concepts in Soilless Farming.	Apply	1	3
2.	Describe the different methods and components of Soilless Farming.	Apply	2	10

| 3. | Illustrate the concept about Hydroponics. | Analyze | 1 | 3 |

TEXTBOOKS:
1. Erin Morrow, "Hydroponics for Beginners", Mihails Konoplovs, 2020.
2. Howard M. Resh, "Hydroponic Food Production: A definitive guidebook for the advanced home gardener & the commercial Hydroponic grower", CRC press, 7th Edition, 2022.

REFERENCE BOOKS:
1. Tom Gordan, "Aquaponics and Hydroponics Gardening 2 in 1", Novelty Publishing LLC, 2020.
2. Tyler Baras, "DIY Hydroponic Gardens", Cool Springs Press, 2018.
3. David Brett, "Hydroponics: How to build your own DIY Hydroponic Garden System", Sbram Ltd., 2020
4. Andy Jacobson, "Hydroponics Essential Guide- A step by step Hydroponic Gardening guide to grow fruits", vegetables and herbs at home, 2nd Edition, 2016.
5. John Mason, "Commercial Hydroponics", Kangaroo Press PVT Ltd., 2012.

https://www.agritecture.com/blog/2019/3/7/soilless-agriculture-an-in-depth-overview

22AH 905 - DIGITAL AGRICULTURE

PREREQUISITE KNOWLEDGE: Intermediate or Equivalent.

COURSE DESCRIPTION AND OBJECTIVES:
Main objective of this subject is to impart knowledge on the Digital resources available in agriculture.

MODULE-1

UNIT-1   **8L+0T+0P=8 Hours**
INTRODUCTION TO DIGITAL AGRICULTURE:
Digital agriculture – introduction and concept; Role of Mass Media in dissemination of farm technology; Modern communication media: electronic video, tele text, tele conference, computer assisted instruction; Concept of digital agriculture; Introduction and overview of Information Communication technologies; Mobile applications – types and purposes; Websites, blogs, RSS feeds – Types and purposes; IoT- Internet of things; Artificial intelligence – concepts; Introduction to Machine learning; Digital agricultural applications in Agriculture; Challenges in the development of digital technology for the agriculture of tomorrow.

UNIT-2   **8L+0T+32P=40 Hours**
DIGITAL RESOURSES FOR CROP MANAGEMENT AND MARKETING:
FAO's 'e-agriculture'; 'e-NAM - National Agriculture Market'; 'm Kisan'; KISSAN (Karshaka Information Systems Service and Networking); VASAT-Virtual Academy for the Semi-Arid Tropics; Mobile applications: KisanSuvidha, PusaKrishi, MKisan Application, ShetkariMasik Android App, Farm-o-pedia, Bhuvan Hailstorm App, Crop Insurance mobile app, AgriMarket, Sikkim Horticulture and CashCrop Assistance, PashuPoshan, MSCS – Multi State Cooperative Societies, Plantix, Digital Mandi India.

PRACTICES:
- Various ICTs in Agriculture – List, how they operate, what they do.
- Identification of farmers problems to provide digital solutions – Field visit to farmers
- Designing of Mobile application by student groups.
- Social media usage in Agriculture (Various Agri specific social media).
- Android studio, Android apps usage in Agriculture.
- IVRS, Broadcast SMS platforms.
- Multimedia management for creating digital content in Agriculture.
- Utilization of AI (Artificial Intelligence) for Weed species Identification.
- AI, Machine Learning (ML) and Deep Learning (DL) for Weed species Identification.
- Digital applications in agriculture to reduce environmental impacts and Economic cost.
- Applications for the tracking of farmers health.
- Applications for the tracking of livestock health in the farm.

MODULE-2

UNIT-1   **8L+0T+0P=8 Hours**
DIGITAL FARM MANAGEMENT:
E-commerce in agriculture, Introduction to E-agriculture; use of IT in agriculture development, strategy, and market implications; advantages of e-agriculture, agribusiness and the internet, E-market place, E- distribution sites, E-procurement sites, benefits of e-commerce adoption in agriculture, forces fuelling e-commerce, Future of E Commerce in agriculture; E-governance

applications of the internet; Introduction to crowd sourcing & big data and its analytics, Introduction to online Supply chain management, Introduction to Block chain technologies, online agricultural education and extension for farmers.

UNIT-2   **8L+0T+32P=40 Hours**
MARKETING AND E-COMMERCE IN AGRICULTURE:
Agriculture models of the future, Data capture (what, why, where, and how), Data collection and transmission (What data to send, when and how), (Agriculture Information System Network) AGRISNET, (Department of Agriculture Cooperation) DACNET, India Development Gateway (InDG), Defence Electronics Application Laboratory (DEAL), i-Kisan, e-Krishi, Alliance for Sustainable & Holistic Agriculture (ASHA), IFFCO-Agri-Portal, Agriwatch Portal, i-shakti. Information and communication technology (ICTs) for market information and Agri-Business: AGMARKNET, e-KRISHI VIPAN, ITC-e-CHOPAL.

PRACTICES:
- Automation in Agriculture.
- Analyzing Farm Data using AI.
- Yield Management using AI.
- Protection of Farmer's Rights on the produce through block chain system.
- Computer modeling to support the analysis and design.
- Application of Block Chain Technology for farm input authenticity.
- Educating local farmers on the available e-resources for the farm management.
- Startups in Digital Agriculture: Prospera, Blue River Technology, Formbot, Harvest CROO Robotics, Gramophone (Agstack Technologies), Jivabhumi etc.

SKILLS:
➢ Acquire knowledge about different e resources available in agriculture.
➢ Expertise in farm management using digital platforms.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1.	Utilization of IoT, Mobile applications and Information Communication technologies for the identification of problems within the field.	Apply	1	3, 8
2.	Able to know the application of digital tools in the field of Agriculture.	Apply	2	3,
3.	Acquire knowledge on usage Blockchain Technology in Agriculture.	Apply	2	3

TEXTBOOKS:
1. Surya Rathore, Vijayalakshmi B, and Sumanth Kumar VV, "Digital Technologies in Agriculture", 2020.

REFERENCE BOOKS:
1. Nikola MT, Samuel V and Meng Z, "Digital Technologies in Agriculture and Rural Areas" Briefing paper, FAO, 2019.

2. Véronique BM, Ludovic B, Frédérick G, Nathalie M and Alexandre T, "Agriculture and Digital Technology: Getting the most out of digital technology to contribute to the transition to sustainable agriculture and food systems", 2022.

3. Tomar P, and Kaur G, "Artificial Intelligence and IoT-based Technologies for Sustainable Farming and Smart Agriculture", IGI Global, 2021.

https://thesecondangle.com/digital-agriculture/

MINOR ON FORENSIC GENOMICS
Offered by Department of Bioinformatics

The crime investigations and consequential decisions have become important aspects of the security and judiciary. In this line, in addition to the regular investigative procedures such as exploration of the links among the culprits, the biological aspects play a key role so as to make the exact identification of the culprit. This is made possible due to the DNA analysis. Because there are 3×10^9 nucleotides base pairs in each of the human cell. Within this genomic sequences, a good number of replicates are unique to the induviduals which constitutes the DNA fingerprinting specific to the individual.

There are five courses included in this Minor. They are (1) Elements of Biotechnology and Bioinformatics which deals with the basic course of cell biology and DNA science as a prelude to genome biology, (2) Fundamentals of Forwensic Sciences handles the topics related to scientific procedures for the crime investigation, (3) Next Generation Sequencing is yet another discipline to unravel the nucleotide sequences of the samples provided, (4) Forensic Genomics deals with the comparative genomics and analysis of genome segments and (5) AI in Genomics and Drug Design is a course wherein the Information Technology tools are applied in genomics.

Forensic genomics addresses how advance in genetic testing and genomic analysis can enable investigators to break through previously impenetrable forensic DNA barriers. Forensic genomics aims to accelerate the validation and adoption of new methods to support investigations that would be otherwise stalled with traditional testing methods. Keeping in view of this, the add-on-minor covers methods of biotechnology and bioinformatics for analysis of forensics applications.

Course Code	Course Title	L	T	P	C
22BI901	Elements of Biotechnology and Bioinformatics	3	0	2	4
22BI902	Fundamentals of Forensic Sciences	3	2	0	4
22BI903	Next Generation Sequencing	3	0	2	4
22BI904	Forensic Genomics	3	0	2	4
22BI905	AI in Genomics and Drug design	3	0	2	4
22BI906	Capestone Project	0	2	6	4

22BI901 –ELEMENTS OF BIOTECHNOLOGY AND BIOINFORMATICS

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of biology

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the central dogma of molecular biology along with molecular methods. The applications of biotechnology in medicine are included. The biological database is bewildering and the same is given emphasis to explore novel genes.

MODULE-1

UNIT-1   **9L+0T+6P = 15 Hours**
FUNDAMENTALS OF BIOTECHNOLOHY:

Scope and importance; DNA structure, function, and metabolism-DNA modifying enzymes and vectors; Methods of recombinant DNA technology; Nucleic acid hybridization; Gene libraries; PCR amplification; Plant and animal cell and tissue culture techniques and their applications.

UNIT-2   **15L+0T+10P=25 Hours**
APPLICATIONS OF BIOTECHNOLOGY:

Molecular markers and their applications; DNA sequencing; Applications of gene cloning in basic and applied research; Genetic engineering and transgenics; Genomics, transcriptomics, and proteomics. General application of biotechnology in agriculture, medicine, animal husbandry, environmental remediation, energy production, and forensics; Public perception of biotechnology; Bio-safety and bioethics issues; Intellectual property rights in biotechnology.

PRACTICES:
- Isolation and visualization of genomic DNA.
- in silico cloning of DNA using Snapgene.
- Amplification of a chosen gene using thermal cycler.

MODULE-2
UNIT-1   **9L+0T+6P=15 Hours**
INTRODUCTION TO BIOLOGICAL DATABASES:

Introduction, biological databases – primary, secondary and structural, protein and gene information resources – PIR, SWISSPROT, PDB, GenBank, DDBJ. Specialized genomic resources. DNA sequence analysis, cDNA libraries and EST, EST analysis, pairwise alignment techniques, database searching, and multiple sequence alignment.

UNIT-2   **15L+0T+10P=25 Hours**
APPLICATIONS OF BIOINFORMATICS:

Secondary database searching, building search protocol, computer-aided drug design– basic principles, docking, QSAR. Analysis packages– commercial databases and packages, GPL software for Bioinformatics, web-based analysis tools. Usage of different online tools for the design of multi-epitope vaccine.

PRACTICES:
- Retrieval of sequences from NCBI, DDBJ.
- Multiple sequence alignment using Clustal Omega.
- Molecular Docking using PyRx.

SKILLS:
- Handling of thermal cycler.
- Retrieving the data from biological database.
- Construction of dendrogram.

COURSEOUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the techniques of biotechnology in health sector.	Apply	1	1,2,5,9,10
2	Adopt principles of Recombinant DNAtechnology.	Apply	1	2,5,9,10
3	Explore biological databases for the viral genes.	Create	2	3,5,9,10
4	Design lead molecules and peptide vaccines using in silico tools.	Create	2	3,5,6,9,10

TEXT BOOKS:
1. Robert A. Meyers,"Encyclopedia of Physical Science and Technology – Biotechnology", Elsevier, 3rd edition, 2001.
2. Bryan Bergeron, "Bioinformatics computing", Prentice Hall/Professional Technical Reference, 1st edition, 2003.

REFERENCE BOOKS:
1. Brown CM, Campbell I&PriestFG, "Introduction to Biotechnology", 1st edition, Panima, 2005.
2. Brown TA, "Gene Cloning and DNA Analysis", 5th edition. Blackwell, 2007.
3. Dale JW& von SchantzM, "From Genes to Genomes: Concepts and Applications of DNA Technology".1st Edition, Wiley &Sons, 2002.

Image source: https://www.rasalifesciences.com/bioinformatics/biotechnology-and-bioinfomatics/
Image file name: ELEMENTS OFBIOTECHNOLOGY& BIOINFORMATICS

22BI902 –FUNDAMENTALS OF FORENSIC SCIENCE

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of biology, Elements of biotechnology and bioinformatics

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the basics of forensic science. The main objective of this course is to provide adequate knowledge to students on the organization and analysis of forensic data.

MODULE-1

UNIT-1   **9L+0T+6P = 15 Hours**

BASICS OF FORENSIC SCIENCSE:

Functions of forensic science. Historical aspects of forensic science. Definitions and concepts in forensic science. Scope of forensic science. Need of forensic science. Basic principles of forensic science. Frye case and Daubert standard. Organizational setup of forensic science laboratories, CFSL, FSL, GEQD, FPB, NICFS, central detective training school, NCRB (Maintenance of Crime Records), NPA mobile forensic science laboratory, branch of forensic science, forensic Science: its International perspective.

UNIT-2   **15L+0T+10P= 25 Hours**

METHOD OF INVISTEGATION:

Modus operandi and MOB and its role in criminal investigation, methods of investigation: Narco analysis: History, importance as an investigative tool, methods as use of drugs, Hypnosis etc. Limitations and legal aspects. Ethics in forensic science. Tools and techniques in forensic science Branches of forensic science. Forensic science in international perspectives, including set up of INTERPOL and FBI. Duties of forensic scientists. Code of conduct for forensic scientists. Qualifications of forensic scientists. Data depiction. Report writing.

PRACTICES:

- Report on history of crime cases from forensic science perspective.
- Analyze examples of crime cases in which apprehensions arose because of Daubert standards.
- Review the sections of forensic science at INTERPOL and compare with those in Central Forensic Science Laboratories in India. Include suggestions for improvements if any.
- Annual reports of National Crime Records Bureau and depict the data on different type of crime cases by way of smart art/templates.

MODULE-2

UNIT-1   **9L+0T+6P=15 Hours**

BRAIN FINGER PRINTING:

Brain finger printing: Significance, method, future perspective of the technique, limitations. Criminal profiling: Introduction, importance, profile of the victim and culprit, understanding *modus operandi*, investigative strategy, crime scene characteristics, criminal behavior on the internet, limitations. Various police organizations, evolution of police as an institution, role & functions of Police.

FINGER PRINT TOOL DEVELOPMENT:
Education of forensic science, role of media, human rights & criminal justice system. Duties of forensic scientist, qualification of forensic scientist. Development of finger print as science for personal identification, type of finger prints, classification of finger prints, latent fingerprint, causes of formation of latent fingerprints, comparison of fingerprints, ridge details. Presentation of expert evidence: Data, reports, evidence in the court.

PRACTICES:
- Report on different type of crime cases.
- Review on how the Central Fingerprint Bureau, New Delhi, coordinates the working of State Fingerprint Bureaus.
- Assess the hierarchical set up of different forensic science establishments and suggest improvements.
- Examine the list of projects undertaken by the Bureau of Police Research and Development and suggest the thrust areas of research in Police Science.
- Compare and contrast the role of a Police Academy and a Police Training School.
- Compare the code of conduct prescribed by different establishments for forensic scientists.

SKILLS:
> Ability to analyze the crime cases using DNA fingerprinting.
> Analyze the various types of fingerprints and assess the culprits

COURSEOUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various methods for crime investigation.	Apply	1	1,2,6,9,10
2	Apply principles and concepts of criminal profiling	Apply	2	1,4,9,10
3	Analyze the results of Narco Analysis with the help of Investigative tool.	Analyze	1	2,4,5,9,10
4	Evaluate and differentiate various types of DNA fingerprints and their applications.	Evaluate	2	3,4,5,9,10

TEXT BOOKS:
1. Nanda B.B. and Tewari R.K, "Forensic Science in India: A vision for the twenty first century", edition, Select, 20021
2. James S.H and Nordby J.J, "Forensic Science: An introduction to scientific and investigative techniques", edition, CRC Press, 2003.

REFERENCE BOOKS:
1.   O Hara & Osterburg, "Introduction to Criminalistics", edition, TheMacMillanCo.,1949.
2.   Osterburg, "Crime Laboratory. Saperstein: Forensic Science, Handbook", edition, Prentice Hall, year.

3.   W.G. Eckert and R.K. Wright, "Introduction to Forensic Sciences", 2nd edition, CRC Press, 1997.

4.   W.J. Tilstone, M.L. Hastrup and C. Hald, "Fisher's Techniques of Crime Scene Investigation", Edition, CRC Press, 2013.

Image source: https://www.thebalancecareers.com/forensic-scientist-524869
Image file name: FUNDAMENTALS OF FORENSIC SCIENCSE

22BI903 - NEXT GENERATION SEQUENCING

Hours per week:

L	T	P	C
3	0	2	4

PRE REQUISITE KNOWLEDGE: Elements of Biotechnology and Bioinformatics

COURSE DESCRIPTION AND OBJECTIVES
This course deals with the sequencing of genomic DNA using NGS tools. It also emphasizes applications in gene expression. It elaborates on the exploration of sequencing genomic data.

MODULE-1

UNIT-1   **9L+0T+6P=15 Hours**
OVERVIEW OF SEQUENCING TECHNOLOGIES:
Overview of model sequencing technologies, Sanger Sequencing, Next Generation sequencing platforms, Whole genome sequencing, Next generation sequencing data analysis: Data acquisition, base calling, Quality of sequencing data, Read mapping, genome assembly. Structural and functional annotation of genomes, Statistics and algorithms used in different steps in data analysis.

UNIT-2   **15L+T+10P=25 Hours**
TECHNOLOGIES FOR TRANSCRIPTOMICS AND REGULATORY GENOMICS:
Chip-sequence analysis, Peak-finding, Motif discovery, RNA-seq analysis, Differential gene expression analysis, Exome sequencing and analysis.

PRACTICES:
- NGS Platforms.
- DNA sequence data analysis.
- NGS resources, tools and databases.
- Whole genome sequencing and Exome sequencing.

MODULE-2
UNIT-1   **9L+0T+6P=15 Hours**
SOFTWARE AND PIPELINES FOR NGS DATA ANALYSIS:
Chip-seq analysis Piplines. RNA-seq analysis pipelines. Software used for assembly and differential gene analysis. Basics of Genome Browsers. Annotation pipelines.

UNIT-2   **15L+0T+10P=25 Hours**
GENOME SEQUENCING AND APPLICATIONS IN GENETICS STUDIES:
Algorithms and application in studying regulation of gene expression. Emerging technologies of single-cell gene expression analysis. Metagenomics. Variant detection. Time series analysis. Pathway Analysis.

PRACTICES:
- Alignment vs Assembly.
- Galaxy usage for analysing NGS datasets.
- Velvet: collection of algorithms for assembling NGS data.
- Gene ontology and pathway analysis.

SKILLS:
- Ability to learn different sequencing platforms
- Identifying gene expression levels.

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply Next Generation Sequencing tools in healthcare.	Apply	1	1,2,5,6,9,10
2	Apply the tools and techniques in NGS data analysis	Apply	2	1,4,5,9,10
3	Analyze the various platforms in NGS	Analyze	1	2,4,5,9,10
4	Evaluate the GWAS using NGS	Evaluate	2	3,4,5,9,10

TEXT BOOKS:
1. Genomic Data Analysis by Megahed Mohammad, LAP Lambert Academic, Publishing
2. Deep Sequencing Analysis by Noam Shomrom, Springer.

REFERENCE BOOKS:
1. JM Bower and H Bolouri, "Computational modeling of genetic and biochemical networks", MIT Press,1st edition, 2005
2. Fall, C.P., Marland, E.S., Wagner, J.M., Tyson, J.J, "Computational Cell
3. Biology", Springer,1st edition, 2002.
4. Choi Sangdun, "Introduction to System Biology", Humana Press/Trtowa/New
5. Jersey, 1st edition, 2010.

Image source: https://www.labmanager.com/product-focus/the-third-wave-of-next-generation-sequencing-22898

Image file name: **NEXT GENERATION SEQUENCING**

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Fundamentals of forensic science
COURSE DESCRIPTION AND OBJECTIVES:
This course deals with the basic concepts of DNA forensics and various tools employed. The main objective of this course is to provide aspects related to the crime investigation using Genomic DNA sequence.

MODULE-1

UNIT-1   **9L+0T+6P = 15 Hours**
FUNDAMENTALS OF DNA FORENSICS:
Fundamentals of DNA forensics and types of PCR: Introduction to DNA forensics, scope and application of DNA forensics in animal and human criminal investigations in variety of situations. Types of PCR: Nested PCR, touch down PCR, gradient PCR, hot-starts PCR, quantitative PCR, multiplex PCR. DNA quantification byslot- blot assay, pico-green micro-titer plate assay, aluQuant human DNA quantification system, endpoint PCR, PCR inhibitors & solutions, contamination issues.

UNIT-2   **15L+0T+10P= 25 Hours**
TECHNIQUES IN DNA FORENSICS:
Uni-parentally inherited genetic markers in ethnic and geographical origin detection, DNA profiling kits (Easy DNA, Pro-filer, etc.) DNA finger printing of degraded samples, Slot-blot assay for quantification of DNA, DNA-DNA hybridization, SNP microarray for supplementary paternity testing. Genetic analysis of chromosome X (pentaplex / heptaplex PCR assay), multicopy Y-STR analysis, mitochondrial DNA analysis, DNA multi-reverse parental analysis.

PRACTICES:
- Carry out separation of organic compounds by paper chromatography.
- Identify drug samples using UV-Visible spectroscopy.
- Examine hair morphology and determine the species to which the hair belongs.
- Prepare slides of scale pattern of human hair.

MODULE-2
UNIT-1   **9L+0T+6P=15 Hours**
FORENSIC DNA EVIDENCE INTERPRETATION:
Advantages, disadvantages and limitations of DNA forensics. Interpretation of DNA typing results: Complicating Factors (Multiple contributors, degradation, and extraneous substances), System-specific Interpretational Issues (RFLP, PCR systems). Assessing strength of evidence: Determination of Genetic Concordance, Evaluation of Results, Frequency Estimate Calculations, Population Substructure, Likelihood Ratios and Uniqueness of DNA Profile.

DNA FINGER PRINTING APPLICATIONS:

Case studies in disputed paternity cases, child swapping, missing person's identity, civil immigration, veterinary, wild life and agriculture cases; Legal perspectives–legal standards for admissibility of DNA profiling–procedural & ethical concerns, status of development of DNA profiling in India & abroad; Limitations of DNA profiling; Population databases of DNA markers–STRs, MiniSTRs, SNPs. Microarrays technology, MALDI-ToF, Mass Spectrometry.

PRACTICES:
- *In silico* design of PCR primers.
- Restriction enzyme analysis using software tools.
- Perform PCR using online software tools.
- Count the dinucleotide/tetranucelotide repeats in the p arm of the X chromosome

SKILLS:
- Develop the knowledge on the genomic tools.
- Apply the software tools for forensic analysis.

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the different PCR techniques in the detection of DNA sequences of the choice.	Apply	1	1,2,6,9,10
2	Apply genomic principles and concepts in criminal profiling.	Apply	2	1,4,9,10
3	Analyze the fragments of restriction digestion for fingerprinting data.	Analyze	1	2,4,5,9,10
4	Evaluate the interpretation of DNA typing.	Evaluate	2	3,4,5,9,10

TEXT BOOKS:

1. Steen Knudsen   A, "Biologist's Guide to Analysis of DNA Microarray Data", 1st edition, Wiley-Interscience,   2002.
2. James S.H and Nordby J.J, "Forensic Science: An introduction to scientific and investigative techniques", edition, CRC Press, 2003.

REFERENCE BOOKS:

1. W.G. Eckert and R.K,"Wright in Introduction to Forensic Sciences", 2nd edition, CRC Press, 1997.
2. R. Saferstein, "Criminalistics", 8th edition, Prentice Hall, 2004.
3. W.J. Tilstone, M.L. Hastrup and C. Hald, "Fisher's Techniques of Crime Scene Investigation",1st edition, CRC Press, 2013.
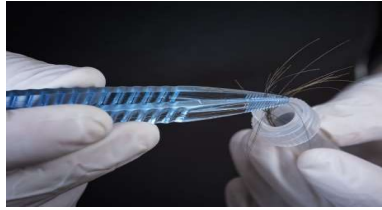
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22BI905 – AI IN GENOMICS AND DRUG DESIGN

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Elements of biotechnology and bioinformatics, Forensic Genomics

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces foundations and state-of-the-art machine learning challenges in genomics and life sciences more broadly. Introduced both deep learning and classical machine learning approaches to key problems, comparing and contrasting their power and limitations.

MODULE-1

UNIT-1   **9L+0T+6P = 15 Hours**

GENE EXPRESSION AND EPIGENOMICS:

Algorithms, machine learning, networks, dynamic programming, reusing computation, iterative functions, exponential / poly; Mixing and mingling social gathering database search, rapid string matching, hashing; Multiple alignment, seq/codon language, alignment score basis HMMs: evaluation, parsing, posterior decoding, learning, HMM architectures, applications, memory, gene finding, chromatin states, conditional random fields (CRFs), sequential modeling.

UNIT-2   **15L+0T+10P= 25 Hours**

EXPRESSION ANALYSIS:

Clustering/classification, K-means, hierarchical, bayesian), RNA-seq, transcript structure, RNA folding; Expression analysis, supervised/unsupervised learning, random forests; Regulatory Motifs: Discovery, representation, PBMs, gibbs sampling, network structure, centrality, SVD, sparse PCA, L1/L2, modules, diffusion kernels; Motif discovery/enumeration, dimensionality reduction, network kernels.

PRACTICES:

- Model the biological sequence using Hidden Markov Models
- scRNA-seq, dimensionality reduction
- Regulatory Genomics CNNs/RNNs in Practice: Diverse Architectures
- Perform Clustering & Classification of Gene Expression data

MODULE-2

UNIT-1   **9L+0T+6P=15 Hours**

AI IN DRUG DISCOVERY:

Machine learning in drug discovery, modern software stack, python foundations, pandas foundations, computational molecular representations, dataset and literature, molecular fingerprints & vectorization, chemical diversity set selection, data visualization [Plotting with python], exploratory molecular data analysis, random split, chemical clustering-based partition, Murcko-scaffold based partition, temporal data partitioning, chemical data bias identification, and evaluation.

UNIT-2   **15L+0T+10P=25 Hours**
DEEP LEARNING IN DRUG DISCOVERY:
Molecular graphs and deep learning on graphs, building ML workflows with Scikit learn and
Python, molecular feature vectors in Python, introduction to Pytorch for chemistry, building
CNNs and RNNs for drug design, Graph Neural Networks in Pytorch, molecule generation with
Python and RL, Autoencoders with Pytorch.

PRACTICES:
- Bioactivity prediction and virtual screening
- Building of Aqueous solubility predictor
- Protein-Ligand Binding Affinity Prediction
- Build drug repurposing models and new molecules generation
- Drug-likeness predictions to conduct a virtual screening
- Building a complete drug discovery pipeline using Pytorch.

SKILLS:
- Predicting Reporter Expression from Chromatin Features
- Single Cell Transcriptomic Data Analysis in Python
- Build drug repurposing models and new molecules generation
- Drug-likeness predictions to conduct a virtual screening

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Acquire the ability to approach novel problems in genomic data science with AI/ML	Apply	1	1,4,5,9,10
2	Apply principles to solve important problems in drug discovery that AI can address	Apply	2	1,2,5,6,9,10
3	Analyze lead molecules using machine learning and deep learning methods.	Analyze	1	1,4,5,9,10
4	Evaluate and get hands-on experience in using various tools, and libraries for various machine learning and deep learning methods	Evaluate	2	1,3,5,9,10

TEXT BOOKS:
1. Good fellow, Ian YoshuaBengio and Aaron Courville, "Deep learning", 1st edition, MIT press, 2016.
2. RoySanjiban Sekhar and Y-H. Taguchi, "Handbook of Machine Learning Applications for Genomics",2nd edition, Springer, 2022.

REFERENCE BOOKS:
1. Bharath Ramsundar, Peter Eastman, Patrick Walters and Vijay Pande, "Deep Learning for the life Sciences", 1st Edition, O'Reily Media, Inc. 2019.
2. Nathan Brown (Ed), Artificial Intelligence in drug discovery, 1st Edition, RSC, 2020.

3. Rami Reddy M, Mark D, "Free Energy Calculations in Rational Drug Design", 1ST edition, Springer   2010

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Image source: https://scopeblog.stanford.edu/2022/06/10/using-ai-to-find-disease-causing-genes/
Image file name: AI IN GENOMICS AND DRUG DESIGN

MINOR ON MEDICAL INSTRUMENTATION
Offered by Department of Bio-Medical Engineering

Medical Instrumentation Engineering is the study of designing, repairing, maintaining, and operating of electronic medical equipment. It is a technical course that focuses on the maintenance and development of medical equipment that measures the physiological data of the patients. It deals with the engineering applications and principles that can be implemented directly in the medical problems pertaining to various issues like diagnosis, assistance, and surgical procedures.

The application of knowledge and technology to problems involving living biological systems is known as medical instrumentation engineering. It entails measuring biological and physiological properties using processing such as ECG, EEG, and EMG signals, as well as medical images obtained from X-Ray, CT, MRI, Ultrasound Scanning, or any other device generated in humans. Human disease diagnosis, treatment, and prevention are all done at the same time.

Biomedical engineers are capable of scanning physiology, biology, clinical healthcare and health informatics, mechanics, and engineering, and can thus combine these skills to create solutions to current global health issues. Rapid advances in bioengineering are being made in artificial organs, implants, bionic arms, and life-saving medical equipment such as ventilators and oxygen concentrations during an emergency. Biomedical engineers benefit society by developing medicines, machines, and devices that assist physicians in diagnosing and treating patients with disease, injuries, or disabilities. Medical instrumentation assists physicians in diagnosing problems and providing appropriate treatment to patients.

Objectives of Medical Instrumentation

The main objective of Medical Instrumentation deals with Screening, Diagnosis, Monitoring, Evaluating and Treatment of diseases. It also covers the fundamentals of measuring respiratory system parameters, sensory response measurement techniques, and the various types and applications of diathermy units. It also teaches ultrasonic therapeutics and diagnosis.

Medical Instrumentation Technology encompasses areas of technology that are used to diagnose, monitor, and treat human diseases. This minor program is designed to give students hands-on experience installing, maintaining, data collection, and processing diagnostic and therapeutic equipment in a healthcare setting. It focuses on the use of multiple sensors to monitor a person's or animal's physiological, chemical, thermal, and mechanical characteristics with knowledge of physiology, biology, and clinical healthcare. Biomedical engineers can use their diverse skills to develop solutions to ongoing global health issues, influencing how patients are treated and lowering healthcare costs. Medical instrumentation minor course consists of Clinical instrumentation, Diagnosis and Therapeutic Equipments, Medical Imaging Modalities, Biomedical Signal and Image Processing.

Key Features of medical Instrumentation:

- Emphasises the electronic aspects of medical instrumentation and current technologies
- Design and development of various medical devices for clinical applications.
- Diagnostic and therapeutic device operation, maintenance, and troubleshooting
- Research-oriented cutting-edge problem-solving methods
- End-to-end process for disease diagnosis and treatment

Future scope of medical instrumentation:

The future of medical instrumentation engineering includes the design and development of various medical devices for clinical applications, as well as opportunities for research and development in clinical, bioelectronics, bionics, biomaterial science, medical ultrasound, biomedical optics and lasers, biomaterials and artificial organs, rehabilitation engineering, surgical devices, higher education, and start-ups.

Course Code	Course Title	L	T	P	C
22BM901	Clinical Instrumentation	3	2	0	4
22BM902	Diagnostic and Therapeutic Equipments	3	0	2	4
22BM903	Biomedical Signal Processing	3	0	2	4
22BM904	Medical Imaging Modalities	3	2	0	4
22BM905	Medical Image Processing	3	0	2	4

22BM901– CLINICAL INSTRUMENTATION

L	T	P	C
3	2	0	4

Hours per week:

https://www.google.com/search?q=basic+clinical+sciences&sxsrf=

PREREQUISITE KNOWLEDGE: Fundamentals of Anatomy & Physiology

COURSE DESCRIPTION AND OBJECTIVES:

A clinical science gives a perceptive to students on various aspects of clinical diseases and the measurable parameters for diagnosis and gives a view on instruments for treatment and other assistive devices.

MODULE-1

UNIT-1   **9L+6T+0P=15 Hours**

NEPHROLOGY:

Principles and types of dialysis, Components of dialyzing system, Dialysate, Composition of dialysate, Types of dialyzers, Clinical significance, Renal transplantation

UNIT-2   **15L+10T+0P=30 Hours**

NEUROLOGY:

Diseases of nervous system (Alzheimer's disease, Parkinson's disease, ALS), Spinal cord lesions, Motor nervous disease, Prolapsed intervertebral disc, Neuropathies, Myasthenia gravis, Diseases of muscle - myopathy.

PRACTICES:

- Design a proto type of reusable dialyzer
- Design a Portable dialyzer
- Records the brain's continuous electrical activity through electrodes attached to the scalp.
- Records the brain's electrical response to visual, auditory, and sensory stimuli
- Case Study: Critical analysis of the symptomatic and asymptomatic symptoms of Alzheimer's disease, Parkinson's disease, ALS.

MODULE-2

UNIT-1   **12L+8T+0P=20 Hours**

GASTROENTEROLOGY:

Anatomy and physiology and G.I.T diseases - stomach (ulcers), liver (jaundice), gall bladder (gall stone); Disease diagnosis and treatment, Juices-Gastric, Bile, Pancreatic, Intestinal, functions and clinically significant symptoms - signs, diseases, Instruments used in gastroenterology.

UNIT-2   **12L+8T+0P=20 Hours**

BIOLOGICAL FLUID ANALYSIS:

General Surgery: Clinically significance, Preoperative care, Postoperative care, Study of operation of surgical equipment, Laparoscopy, Endoscopy and intubation tubes.

Pathology & Blood Bank: ESR, Electrolyte estimation of normal values, HIV test - ELISA, dot method, cross matching of blood, cell counter, normal blood coagulation factors, normal bilirubin.

PRACTICES:
- Distinguish different diagnostic test process of gastrointestinal disorders.
- Evaluate the Instruments used in gastroenterology.
- Case Study: Pre and Postoperative care of cancer patient.
- Evaluate the Laparoscopy, Endoscopy and intubation tubes.
- Determination the ESR / ELISA / Blood cell counting (dot / cross matching method) using microscope.

SKILLS:
- Demonstration of instruments and kidney transplantation
- Analyse the various diseases and their appearances**.**
- Determine the physics behind diagnostic instruments.
- Application of Pre and Postoperative care procedures
- Identify different disease and symptoms

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of dialysis to analyse the performance of dialysis of treatment and design of dialyzer	Apply	1	1, 2, 9,10,12
2	Apply the conditions and symptoms for identification of neurological diseases	Apply	1	1, 2, 4,6 9,10, 12
3	Analyse the diseases of the GI tract and instruments used for diagnosis.	Analyze	2	1, 2, 5, 6, 9,10,12
4	Analyse the conditions of patient in pre and post-operative cares of patient	Analyze	2	1, 2, 4, 6, 9,10,12
5	Categorize the blood transfusion compatibility based on grouping and other important factors using the blood cell counters/ESR/ELISA	Evaluate	2	1, 2,4,5, 9,10,12

TEXT BOOKS:
1. Elaine.N.Marieb, "Essential of Human Anatomy and Physiology",12th edition, Pearson Education, 2017.
2. Gerard J. Tortora, Bryan D. "Principles of Anatomy and Physiology", 14thedition, John Wiley & Sons INC, 2014.

REFERENCE BOOKS:
1. Michael Zigmond, Joseph Coyle, Lewis Rowland, "Neurobiology of Brain Disorders", Academic Press, 2014.
2. Jeffrey A. Morgan, Andrew B. Civitello, O.H. Frazier, "Mechanical Circulatory Support for Advanced Heart Failure", Springer, 2018.
3. Jones DB, Wu JS, Soper NJ, "Laproscopic surgery: Principles and Procedures", 2nd edition, Marcel Dekker, 2019.

22BM902 - DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Analog circuits, Analog and linear ICs

COURSE DESCRIPTION AND OBJECTIVES:

This course explains the concepts about human-instrument system and problems encountered in obtaining measurements from a living body. It also deals with basics of measuring the parameters in respiratory system, learn measurement techniques of sensory responses and understand different types and uses of diathermy units. It also gives knowledge of ultrasonic therapeutics and diagnosis.

MODULE-1

UNIT-1   **9L+0T+6P=15 Hours**

PATIENT MONITORING SYSTEMS:

Special care units, ICU/CCU equipments, Bed side patient monitoring systems – multi-parameters, measurement of heart rate and pulse rate, Holter monitor, phonocardiography, plethysmography, recording system; Oximeters -principle, intravascular oximeter; Cardiotacograph, Methods of monitoring foetal heart rate, Monitoring labour activity, Baby incubator.

UNIT-2   **15L+0T+10P=25 Hours**

DIATHERMY: Short wave diathermy, Ultrasonic diathermy, Microwave diathermy, Electro surgery machine - current waveforms, tissue responses, electrosurgical current level, surgical diathermy analyzers, hazards and safety procedures.

AUTOMATED DRUG DELIVERY SYSTEMS: Infusion pumps, Components of drug infusion pumps, Implantable infusion systems, Closed loop control in infusion systems, Programmable controlled insulin dosing device.

PRACTICES:

- Multipara meter monitoring system.
- Heart sound measurement using phonocardiography
- Design Cardiotacometer
- Design phonocardiography
- Design Patient monitoring system
- Shortwave diathermy
- Ultrasonic diathermy
- Long wave diathermy
- Inspection ESU – cutting and coagulation modes.
- Design syringe and Infusion Pumps

MODULE-2

UNIT-1   **12L+0T+8P=20 Hours**

EXTRA CORPOREAL DEVICES AND THERAPEUTIC TECHNIQUE:

Lithotripsy - Stone Disease Problem, First Lithotripter Machine, Modern Lithotripter Systems; Extracorporeal Shockwave Therapy, Principles of Cryogenic Technique and Application, Thermotherapy, Hyperthermia, High Intensity Focused Ultrasound (HIFU), Thermography – Recording and Clinical Application.

UNIT-2   **12L+0T+8P=20 Hours**

ELECTRICAL SAFETY:

Physiological effects of electricity, Importance susceptibility parameters, Distribution of electric power, Macro shock hazards, Microshock hazards, Electrical - safety codes and standards, protection against shock; Protection - electrical safety analyzers, testing electric system, tests of electric appliances, problems.

PRACTICES:
- Predict the thermal effects of tissue by operation of Hyperthermia through simulation
- Predict the thermal effects of tissue by operation of High intensity focused ultrasound therapy simulation
- Electrical safety measurements
- Examine the Protection of electrical safety issue of instruments

SKILLS:
- Differentiate various instruments in hospitals for trouble shooting
- Determine diagnostic techniques used in health care.
- Investigate the breakdown of diagnostic and therapeutic equipments.
- Evaluate the procedures for safely carrying out therapeutic process

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Classify critical equipment into various units	Analyze	1	1, 2, 9,10
2	Distinguish the different diathermy equipment by applying physics laws and Evaluate the diathermy units to estimate the treatment plans.	Analyze	1	1, 2,4, 5, 9,10
3	Design the components and working of drug delivery systems	Analyze	1	1, 2, 3, 5, 9,10,12
4	Apply ultrasound physics to realize the treatment of kidney stones, cancer	Analyze	2	1, 2,4, 9,10
5	Evaluate the electrical safely carrying out therapeutic devices in hospitals	Evaluate	2	1, 2,4,5, 9,10

TEXT BOOKS:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd edition, Tata McGraw Hill, 2014.
2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", 4rd edition, Prentice Hall, 2015.

REFERENCE BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, John Willey and Sons, 2015.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", 4th edition, Pearson Education, 2004.
3. L.A Geddas and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd edition, 2017.
4. Myer Kutz "Standard Handbook of Biomedical Engineering and Design", McGraw-Hill Publisher, 2013.

22BM903 - BIOMEDICAL SIGNAL PROCESSING

Hours per week:

L	T	P	C
3	0	2	3

https://usharama.edu.in/blogDetail/biomedical-signal-processing

PREREQUISITE KNOWLEDGE: Signals and Systems

COURSE DESCRIPTION AND OBJECTIVES:

This course presents relationships among different theoretical measures of biomedical signals and an understanding of the information. Biomedical engineering involves the application of engineering methods for the improvement of human health; the signals encountered by biomedical engineers are typically derived from biological processes. This course imparts the knowledge of signal processing of all bio-potentials and their corresponding transforms.

MODULE-1

UNIT-1   **15L+0T+10P=25 Hours**

FUNDAMENTALS OF DISCRETE-TIME SIGNALS AND SYSTEMS:

Concepts of systems and signal, Z-transform, Discrete Fourier transform (DFT), Fast Fourier transform (FFT), Medical applications.

Biomedical Signal Biomedical signal origin, Dynamics ECG, EEG, EMG signal and its characteristics, Filtering for removal of artifacts; Statistical preliminaries - random noise, structured noise, stationary vs non stationary processes; Time domain filtering (synchronized averaging, moving average).

UNIT-2   **9L+0T+6P=15 Hours**

ELECTROCARDIOGRAM (ECG):

Heart rhythms, Heart beat morphologies, Noise and artifacts, Base line wander, Power line interference, Muscle noise filtering, QRS detection, Wave delineation, Data compression, Heart rate variability, Spectral analysis of heart rate variability.

PRACTICES:

- Find the output y(n) for an input x(n), for the discrete time system represented by impulse response h(n).
- Compute Linear Convolution and circular for two sequences.
- Compute the Discrete Fourier Transform and IDFT with and without FFT and IFFT
- Implementation of Decimation-in-time / Decimation-in-frequency radix-2 FFT algorithm.
- Find the Fourier transform, frequency response of x(n), and plot its magnitude and phase.
- Compute the Discrete Fourier Transform and IDFT with and without FFT and IFFT.
- Data polishing removal of power line interface from ECG
- Display static and moving ECG signal
- Spectrum analysis of ECG Signals.

- Detect QRS complex and measure the heart rate of a given ECG signal

MODULE-2
UNIT-1   **12L+0T+8P=20 Hours**
ELECTROENCEPHALOGRAM(EEG):
Applications, Modeling - deterministic and stochastic properties, linear, stochastic models, nonlinear modeling of the EEG; Artifacts - artifacts characteristics, artifact cancellation using linearly combined reference signals, adaptive artifact cancellation using linearly combined reference signals; Noise reduction by ensemble averaging, Nonparametric and model based spectral analysis, EEG segmentation, Evoked potential modalities.

UNIT-2   **12L+0T+8P=20 Hours**
ELECTROMYOGRAM (EMG):
The electrical activity of muscles, Amplitude estimation in the surface EMG, Spectral analysis of the surface EMG, Conduction velocity estimation, Modeling the EMG, EMG signal decomposition.

PRACTICES:
- Classification of EEG signals and analysis.
- Detection of EEG rhythms, Template matching for EEG, spike and wave detection
- Removal of Artifacts in the EEG
- Removal of Artifacts in the EMG
- EEG rhythms, waves, and transients
- Analysis of EMG Signals

SKILLS:
- Analyze different biopotential signals using Lab View/MATLAB.
- Test and design a stable system (ECG, EMG, EEG kit).
- By deeply understating the physiological signals and systems can design different vital monitoring systems.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply basic concepts of discrete time biomedical signals and systems	Apply	1	1, 2, 4, 5, 9,10
2	Apply filters and averaging techniques to remove noise and extract features of biomedical signals, also to evaluate performance of algorithms	Apply	1	1, 2, 5, 9,10
3	Develop simple algorithms and Evaluate performance of ECG, EMG and EEG that will serve the basis in career	Analyze	1	1, 2, 3, 5, 9,10,12
4	Analyze the biomedical signals ECG, EMG and EEG and its interpret the nature	Analyze	2	1, 2,5, 9,10

5	Verify various transform techniques and filters and evaluate the physiological signals by applying signal processing techniques using Matlab.	Evaluate	2	1, 2, 4,5, 9,10,12

TEXT BOOKS:

1. N.Vyas, "Biomedical Signal Processing", University Science Press, New Delhi, 2014.
2. Rangaraj M. Rangayyan, Akay Metin (Editor), "Biomedical Signal processing", 1st edition, IEEE Press, 2014.

REFERENCE BOOKS:

1. Leif Sornmo and Pablo Laguna, "Bioelectrical Signal Processing in Cardiac and Neurological applications", 3rd edition, Academic Press, 2005.
2. Mahesh Kumar H.Kolekar, "Biomedical Signal and Image Processing in patient care ", IG Globl, 2017.
3. Ganesh Naik, "Biomedical Signal Processing- Advances in theory, Algorithms and Applications, Springer, 2020.

22BM904 - MEDICAL IMAGING MODALITIES

https://openmedscience.com/medical-imaging/

Hours per week:

L	T	P	C
2	2	0	4

PREREQUISITE KNOWLEDGE: Engineering Physics, signals and systems, Biomedical Instrumentation.

COURSE DESCRIPTION AND OBJECTIVES:

This course studies the image reconstruction techniques, quality assurance test for radiography, method of recording sectional image, functioning of radioisotopic imaging equipment and the MRI, image acquisition and reconstruction, it also explains the 3-D image display techniques. This course aimed at imparting knowledge of operation and medical applications of the major medical imaging techniques.

MODULE-1

UNIT-1   **8L+8T+0P=16 Hours**

INTRODUCTION:

X-ray, CT, Ultrasound, MRI, PET-CT, SPECT-CT, Gamma Camera, Catheterization Lab. Image perception, Image acquisition, Display, Image processing operations, scanning.

X-Ray: X-Ray imaging, Fundamentals of X-ray, Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and detection of X-rays, biological effects of ionizing radiation; X-Ray diagnostic methods - conventional X-ray radiography, fluoroscopy, angiography, mammography and xeroradiography.

CT: Conventional tomography, Computed tomography - projection function, algorithms for image reconstruction, multiplanar reconstruction, non-spiral CT technology, concepts of spiral CT scanner, multi slice spiral technology, Recent applications – CT angio, cardiac CT, dual energy CT.

UNIT-2   **8L+8T+0P=16 Hours**

ULTRASOUND IMAGING: Fundamentals of acoustic propagation - characteristic impedance, intensity, reflection and refraction, attenuation, Doppler effect; Generation and detection of Ultrasound - piezoelectric effect, ultrasonic transducers.

ULTRASONIC DIAGNOSTIC METHODS: Pulse echo systems - amplitude mode (A-mode), brightness mode (B-mode), motion mode (M-mode), 3D, 4D, Doppler methods, duplex imaging, colour Doppler flow imaging, image artifact, biological effects of ultrasound.

PRACTICES:

- Analyse the radiation exposure to patients by using low kV values
- Evaluate the prevention of unnecessary exposure to patients in digital radiography
- Evaluate the rejection analysis in radiography reduce unnecessary exposure to patients
- Determines the Quality of the chemical processing of radiographic film have any effect on the radiation exposure of a patient
- Determines the radiation dose to the breast of patients in mammography
- Determines the radiation exposure to a patient affected by the size of the image
- Apply the reconstruction techniques of the CT images for generation of image
- Analysis the radiation doses to patients undergoing cardiac CT procedures compare to doses from other radiographic procedures
- Design and Develop the ultrasound transducer
- Determines the ultrasound modes for examine the diseases

MODULE-2

UNIT-1   **8L+8T+0P=16 Hours**

MAGNETIC RESONANCE IMAGING: Basics of magnetic resonance imaging, Fundamentals of nuclear magnetic resonance - angular momentum, magnetic dipole moment, magnetization, larmour frequency, free induction decay (FID), Fourier spectrum of the NMR signal, spin density, relaxation times, pulse sequences.

MRI SYSTEM & IMAGING METHODS: Introduction, Magnet, NMR Coil/Probe, Transmitter, Receiver, Data acquisition; Imaging methods - introduction, slice selection, frequency encoding, phase encoding, spin-echo imaging, gradient echo imaging; Characteristics of MRI images - spatial resolution, image contrast, biological effects of magnetic fields, static magnetic fields, radiofrequency fields, gradient magnetic fields, imaging safety, functional MRI (brief introduction only).

UNIT-2   **8L+8T+0P=16 Hours**

NUCLEAR IMAGING:

Physics of gamma camera, Basic instrumentation, Imaging techniques, SPECT and whole body studies; Applications of gamma camera in cardiology, Nephrology, Neurology etc., PET - fundamentals of PET scanner and PET- CT, crystal technology, cyclotron principle, Applications of PET - cardiology, neurology and cardiology.

PRACTICES:
- Analysis the MRI compare with doses from other examinations.
- Determine the reconstruction techniques of the MRI images for generation of image

- Analysis the PET/CT radiation doses compare with doses from other examinations.
- Determine the patient exposure PET/CT radiation given in an examination
- Determine the optimize image quality in a gamma camera examination
- Determine the optimization in diagnostic nuclear medicine

SKILLS:

➢ Study the physics behind medical imaging.
➢ Determine the basis for an image is formation.
➢ Know the image formation in MRI.
➢ Grasp the knowledge of CT and importance of a medical department.
➢ Image acquisition and processing of images for required model.
➢ Integration of CT_PET for structural and functional analysis of disease.
➢ Calculate dose limits and differentiate between controlled areas and radiation hazards.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse the CT image reconstruction techniques using different algorithms.	Apply	1	1, 2,3,4, 9,10
2	Apply the concepts of ultrasound image formation model and analyse the biological effects.	Apply	1	1, 2, 5, 9,10,12
3	Identify MRI pulse sequences & hardware systems for tissues imaging and its hardware.	Analyze	1	1, 2, 4, 5, 9,10,12
4	Analyse the nuclear spins and the decay systems of NMR.	Analyze	2	1, 2,4,5, 9,10,12
5	Analyse the SPECT- PET imaging formation techniques in cardiology and neurology.	Evaluate	2	1, 2, 4,5, 9,10

TEXT BOOKS:

1. Kirk Shung, Michael B. Smith and Banjamin Tsui, "Principles of Medical Imaging", Academic Press, 2015.

2. Paul Suetens, "Fundamentals of Medical Imaging", 3rd edition, Cambridge University Press, 2017.

REFERENCE BOOKS:

1. Michael Chappell, "Principles of Medical Imaging for Engineers", Springer, 2019.

2. Stewart C. Bushong, Geoffrey Clarke "Magnetic Resonance imaging –Physical and biological principles", Elsvier, 4th edition,2014.

3. Hykes, Heorick, Starchman, "Ultrasound physics and Instrumentation", MOSBY, 6th edition, 2021.

4. Russell K Hobbie, Bradley J Roth, "Intermediate physics for medicine for biology, Springer, New York, 4th edition, 2013.

22BM905 - MEDICAL IMAGE PROCESSING

Hours per week:			
L	T	P	C
3	0	2	4

https://miro.medium.com/max/600/1*CG8POmsTy2h6rzDQsbDPzA.jpeg

PREREQUISITE KNOWLEDGE: Medical Imaging Techniques, Biomedical Signal Processing.

COURSE DESCRIPTION AND OBJECTIVES:

This course imparts the working knowledge of medical image processing, various techniques of transformation, enhancement, restoration, compression, segmentation and image morphology. The course gives the knowledge of all kinds of image processing in biomedical applications.

MODULE-1

UNIT-1   **9L+0T+6P=15 Hours**

IMAGE FUNDAMENTALS: Introduction, Steps in digital image processing, Components, Elements of visual perception, Image sampling and quantization, Relationships between pixels, Color models.

IMAGE ENHANCEMENT: Gray level transformations, Histogram processing, Basics of spatial filtering, Smoothing and sharpening spatial filtering; Frequency domain - introduction to Fourier transform, smoothing and sharpening; Frequency domain filters - ideal, Butterworth and Gaussian filters.

UNIT-2   **15L+0T+10P=25 Hours**

IMAGE RESTORATION: Noise models, Mean filters, Order statistics, Adaptive filters, Band reject filters, Band pass filters, Notch filters, Optimum notch filtering, Inverse filtering, Wiener filtering.

PRACTICES: using MATLAB / Python:

- Determine Image sampling and quantization
- Analysis of spatial and intensity resolution of images
- Determine Intensity transformation of images.
- Analysis of images with different color models
- Histogram processing.
- Image enhancement spatial filtering.
- Image enhancement filtering in frequency domain

- Image filtering -Adaptive filters, Band reject filters, Band pass filters, Notch filters, Optimum notch filtering, Inverse filtering, Wiener filtering.
- Analysis of images with different color models.

MODULE-2

UNIT-1   12L+0T+8P=20Hours

THRESHOLDING AND SEGMENTATION: Detection methods, Optimal thresholding, Multi-spectral thresholding; Edge based segmentation, Region based segmentation, Matching, Advanced optimal border and surface detection approaches, thresholding, applications – US, MRI, CT images.

IMAGE REPRESENTATION AND RECOGNITION: Boundary representation - chain code, polygonal approximation, signature, boundary segments, boundary description, shape number, Fourier descriptor, moments regional descriptors, topological feature; Texture - patterns and pattern classes, recognition based on matching.

UNIT-2   12L+0T+8P=20 Hours

MATHEMATICAL MORPHOLOGY: Basic morphological concepts, Morphological principles: Binary dilation and erosion, Gray scale dilation and erosion, skeletons and object marking, graundometry, Morphological segmentation and water sheds; Applications of image processing techniques to MRI Images, Dicom, CT and Functional MRI images.

PRACTICES:

- Image segmentation edge detection, line detection and point detection.
- Region based image segmentation
- Thresholding based image segmentation
- Basic morphological operations.
- Morphological segmentation and water sheds

SKILLS:

- ➢ Process medical images using different techniques.
- ➢ Diagnose abnormalities in a given health problem relative to imaging.
- ➢ Gain knowledge to write or device their own model for specifically pertaining problems
- ➢ Critically understand the mathematics behind image processing

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the various transforms to enhance images in frequency domain	Apply	1	1, 2, 9,10,12
2	Apply image segmentation and restoration techniques to US,CT,MRI images	Apply	2	1, 2, 5, 9,10, 12
3	Analyze the techniques for image representation.	Analyze	1	1, 2, 5, 9,10,12
4	Apply the techniques of mathematical morphology useful for image processing	Apply	2	1, 2,5 9,10,12
5	Develop program for processing a medical image by various algorithms for different applications	Creative	2	1, 2,3,4, 9,10

TEXT BOOKS:

1. Rafael C, Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 3rd edition, 2020.

2. Jayaram, Kudupa and Gabor, T Herman, "3D imaging in medicine", 2nd edition, CRC press, 2000.

REFERENCE BOOKS:

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image processing, analysis and machine vision, 4th edition, Brooks/Cole Publishing Co., 2014.

2. John C Russ, "The image processing handbook", 6th edition, CRC and IEEE press, 2011.

3. Milan Sonka, "Digital Image Processing and Computer Vision", 3rd edition, India edition, 2013.

MINOR ON COMMUNITY HEALTH

Offered by Department of Biotechnology

The Add-On Minor on Community health offered by the Department of Biotechnology os to impart the awareness on Public Health and Community Medicine. This is an essential aspect to safeguard the inhabitants in the community which constitutes the niche for a group of people. The Governments also are focusing the attention on the welfare of the communities that are part from the metro cities. Hence, the minor program on Community Health is provided for the Engineering students to opt so as to make them involve in their life-time in their community.

The Community Healthprogram contains fice courses. They are as follows: (1) Molecular Diagnostics, a course that deals with the skill in acquiring the knowledge on protocols, (2) Community medicine and Public Healthdeals with the international health supporting agencies and health planning, (3) Vaccine Preventable Diseases contains the topics of the communicable diseases that spread across the community on the population, (4) Medicinal Plants and Ethnobotany course contains the topics that deals with the important endemic plants useful for ailments and (5) Vector-Borne Diseases is yet another course which focuses on the vectors that transmit the infection in the community.

Community medicine is concerned with the prevention of disease, the determinants and natural history of disease in populations, and the influence of environment and society on health and disease. This minor stream is emphasized on diagnostic methods, impact of vaccination and medicinal plants etc., The main intention of offering this stream is to create awareness among student community about community diseases prevention & control and also to create a platform for research in the area of community health.

Course Code	Course Title	L	T	P	C
22BT901	Molecular diagnostics	3	0	2	4
22BT902	Community medicine and Public Health	3	2	0	4
22BT903	Vaccine Preventable Diseases	3	0	2	4
22BT904	Medicinal Plants and Ethnobotany	3	0	2	4
22BT905	Vector Borne Diseases	3	2	0	4
22BT906	Project	0	2	6	4

22BT901 - MOLECULAR DIAGNOSTICS

Hours per week:			
L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of Biology

COURSE DESCRIPTION AND OBJECTIVES: The course deals with the molecular diagnostics in the clinical laboratory such as nucleic acid hybridization, PCR, Molecular markers and ELISA. This course also covers the diagnosis of genetic and communicable diseases.

MODULE-1

UNIT-1   **9L+0T+6P=15 Hours**
NUCLEIC ACID BASED METHODS:
DNA structure, function; DNA modifying enzymes and vectors; Methods of recombinant DNA technology; Nucleic acid hybridization; Gene libraries; PCR amplification; animal cell and tissue culture techniques and their applications.

UNIT-2   **15L+0T+10P=25 Hours**
MOLECULAR MARKERS AND THEIR APPLICATIONS IN HUMAN DISEASES:
PSA, BRCA; Leukocyte and Lymphocyte markers; DNA sequencing; Applications of gene cloning in basic and applied research; Animal husbandry and Forensics; Bio-safety and bioethics issues; Intellectual property rights in biotechnology.

PRACTICES:
- Isolation and Quantification of DNA and Protein.
- in silico cloning of DNA fragment into vector using Snapgene.
- Insilco PCR.
- Primer design for PCR.

MODULE-2

UNIT-1   **9L+0T+6P=15 Hours**
BIOLOGICAL DATABASES:
Primary, secondary and structural; Protein and Gene Information Resources – PIR, SWISSPROT, PDB, GenBank, DDBJ; Specialized genomic resources; DNA sequence analysis; cDNA libraries and EST; EST analysis; Pairwise alignment techniques; Database searching and multiple sequence alignment.

UNIT-2   **15L+0T+10P=25 Hours**
APPLICATIONS OF BIOINFORMATICS:
Computer-aided drug design; QSAR; Usage of different online tools for the design of multi-epitope vaccine; Polytope vaccines; Recombinant vaccines; DNA based vaccines.

PRACTICES:
- Retrieval of sequences from NCBI, DDBJ.
- Multiple sequence alignment using Clustal Omega.
- Molecular Docking using PyRx.
- Design of multi-epitope vaccine.

SKILLS:
- Application of DNA based diagnostics for disease identification.
- Use of molecular markers for disease prognosis.
- Design of lead molecules using bioinformatics tools.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the diagnostic tools for disease identification	Apply	1	2,3,4,5,6,7
2	Explore communicable and non-communicable diseases	Apply	1	2,4,6,9,10
3	Identify the lead molecules using bioinformatics tools	Analyze	2	1,4,,9,10
4	Design epitope based and DNA based vaccines for the viral diseases using online tools	Create	2	3,4,5,6,8,9,10

TEXT BOOKS:
1. Becker JM, Coldwell GA & Zachgo EA, "Biotechnology – A Laboratory Course", 2nd edition, Academic Press, 1996.
2. Attwood TK & Parry-Smith DJ, "Introduction to Bioinformatics", 1st edition, Pearson Education, 2003.

REFERENCE BOOKS:
1. Brown TA, "Gene cloning and DNA analysis: an introduction", 8th edition, Wiley-Blackwell, 2020.
2. Michael R. Green, Joseph Sambrook, "Molecular Cloning – a Laboratory Manual", 4th edition, Cold Spring Harbor Laboratory Press, 2012.
3. Rastogi SC, Mendriratta N, Rastogi P, "Bioinformatics: Concepts, Skills & Applications", 2nd edition, CBS, 2006.

Image source: https://diagnostics.roche.com/global/en/products/product-category/molecular-diagnostics.html

Image file name: **MOLECULAR DIAGNOSTICS**

22BT902 - COMMUNITY MEDICINE AND PUBLIC HEALTH

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Environmental Science, Basics Biology

COURSE DESCRIPTION AND OBJECTIVES:

The course provides an overview on the health security and support rendered by international agencies. The topics related to Geriatric health, homes for physically and mentally challenged individuals, destitute and health planning in India from the primary source namely Panchayat Raj etc., are introduced.

MODULE-1

UNIT-1   **9L+6T+0P=15 Hours**

PUBLIC HEALTH:

Evolution of public health, public health acts, various types of census; Health problems of developed and developing countries; Health insurance policies. Immunization and herd immunity; Disease burden-cancer, diabetes and hepatitis.

UNIT-2   **15L+10T+0P=25 Hours**

HEALTH AGENCIES:

International - WHO, NIH, UNFPA, UNDP, FAO, UNICEF, DANIDA, red cross, USAID, UNESCO, colombo plan, ILO, CARE; National – ICMR, Indian Red Cross, Indian Council for child welfare, Family Planning Association of India (FPAI), tuberculosis association of India, Hindu Kusht Nivaran Sangh, Central social welfare board.

PRACTICES:

- Evaluate the data on the cancer diseases in India and prepare a map with the risk factors.
- Map Cervical cancer in India with and without HPV vaccinated subjects.
- Search the data on Hepatitis B infection and evaluate the burden due to unvaccinated subjects.
- Browse the data on Covid-19 pandemic. Prepare a grid showing the pre and post vaccination situation in India.

MODULE-2

UNIT-1   **9L+6T+0P=15 Hours**

EPIDEMIOLOGY:

Definition and concepts of epidemiology; Concepts of health and disease; Role of genetics in health and disease; Levels of prevention; Types of epidemiology; Uses of epidemiology; Maintenance of health records of family; Food adulteration; Geriatric health; Old age homes; Orphanage; Homes for physically and mentally challenged individuals; Homes for destitute.

UNIT-2   **15L+10T+0P=25 Hours**

HEALTH PLANNING IN INDIA:

National health policy and millennium goals and visions; Organized sector with reference to Centre, State, district and Block level structures and local bodies and panchayati Raj; Organization and functions of community health centers and primary health centers; Health

Manpower; Alternative systems like AYUSH.

PRACTICES:
- Compile the data on live births registered in India and interpret.
- Collect the data on Childhood vaccination and its schedule.
- Prepare the data on Adult vaccination in India and prepare a pamphlet for its promotion.
- Report on the pros and cons of National Health Policy.
- Browse the data on the Geriatric health and old age homes and interpret.

SKILLS:
- Adjudge the activities of national & international health organizations.
- Development of strategies to prevent the spread of communicable diseases.
- Guarding the health of orphans, physically handicapped and senior citizens.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	**Apply** the control strategies for eradication of epidemiological diseases.	Apply	1	1,6,7,9,10
2	**Analyze** the importance of good health in the community.	Analyze	1	2,4,6,7,9,10
3	**Investigate** the occupational hazards.	Analyze	1	2,4,6,7,9,10
4	**Analyze** the seasonal variation and consequent infections of both viral and bacterial pathogens.	Analyze	2	2,4,6,7,9,10
5	**Create** the awareness on herd immunity, ethnobotany, homeopathy and Ayurveda.	Creating	2	3,4,6,7,9,10

TEXT BOOKS:
1. Roy, Rabindra Nath, "Mahajan & Gupta Textbook of Preventive and Social Medicine", 4th edition, Jaypee Brothers Medical Publishers, 2013.
2. Merrill RM, "Fundamentals of epidemiology and biostatistics: Combining the basics", 1st edition, Jones & Bartlett Learning, 2013.

REFERENCE BOOKS:
1. Schneider M J, "Introduction to public health", 1st edition, Jones & Bartlett Learning, 2020.
2. Sana Loue, Sana Loue, Martha Sajatovic, "Encyclopedia of Aging and Public Health" 1st edition, Springer, 2008.
3. KV Ramani, "Global Public Health Policies: Case Studies from India on Planning and Implementation" 1st edition, Business Expert Press, 2015.

Image source: https://www.upstate.edu/publichealth/
Image file name: COMMUNITY MEDICINE AND PUBLIC HEALTH

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Immunology and Immunoinformatics

COURSE DESCRIPTION AND OBJECTIVES:
This course offers topics relating to the diseases that arise as a consequence of environmental hazards. Further, vaccine platforms and computational tools are provided to acquaint the students to develop the disease control techniques for community health management.

MODULE-1
UNIT-1   **9L+0T+6P=15 Hours**
VACCINE PLATFORMS:
Importance of vaccination; Diseaseburden due to vaccine preventable diseases; Immunization: live, killed, attenuated, Recombinant vaccines, DNA, RNA Vaccines; Vaccination routes; Properties of adjuvants; Pneumococcal conjugate vaccines; Toxoids and anti-Toxins, Epitopes and tools; Allergy prediction tools.

UNIT-2   **15L+0T+10P=25 Hours**
BURDEN DUE TO VIRAL DISEASES:
Rubella, Hepatitis B, Influenza,Chicken Pox, Herpes Zoster, Covid-19.

PRACTICES:
- Antigen selection from the viral pathogens of our choice.
- Browsing NCBI forthe sequence of the chosen antigen.
- Prediction of sequential and conformational epitopes for the chosen antigen.
- Epitope prediction using RANKPEP.
- Allergy prediction using AllerTop.
- Construction of a grid showing the disease model for any two viral diseases.

MODULE-2
U N I T - 1   **9L+0T+6P=15 Hours**
BURDEN DUE TO VECTOR BORNE DISEASES:
Malaria, lymphatic filariasis, sleeping Sickness, dengue and chikungunya, recommended vaccines for adults, children and females.

UNIT-2   **15L+0T+10P=25 Hours**
VACCINE DESIGN:
Selection of the sequence of an antigen; Antigen prediction; Epitope prediction; MHC and TCR binding of peptides; HLA haplotypes and population coverage; Use of online tools- IEDB, RANKPEP, PEPVAC, MULTIPRED, ALLERTOP, C-ImmSim, TOXINPRED, VAXIJEN.

PRACTICES:
- Population coverage for vaccine construct using IEDB server.
- Explore the HLA haplotypes of South India.
- Navigation of C-ImmSim for predicting cytokine storm and Immune cellresponse.

- Design a peptide-based vaccine using computational tools.
- Constructing a grid showing the disease model for any two vector borne diseases.

SKILLS:
- Prediction of the burden in the community due to viral diseases.
- Prediction of the burden in the community due to vector-borne diseases.
- Promoting the public in the community for mass vaccination to develop herd immunity.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Explore seasonal viral diseases erupting in the community.	Apply	1	2,4,6,7,9,10
2	Analyze various vaccine platforms to decrease the disease burden.	Analyze	1	2,4,5,6,9,10
3	Compile the diseases in the community due to insect vectors.	Analyze	2	2,4,6,7,9,10
4	Design the strategy for promoting vaccination as per the national vaccine policy among the public in the community.	Creating	2	3,4,6,7,9,10

TEXT BOOKS:
1. Murphy, Kenneth, and Casey Weaver, "Janeway's immunobiology", 9th edition, Garland science, 2016.
2. Morrow WJ, Sheikh NA, Schmidt CS, Davies DH, "Vaccinology", 1st edition, Wiley-Blackwell, 2012.

REFERENCE BOOKS:
1. Bennett JE, Dolin R, Blaser MJ. Mandell, Douglas, and Bennett's, "Principles and practice of infectious diseases", 9th edition, Elsevier, 2019.
2. Mishra NK, Sharma AK, "Immunoinformatics: A Modern Immunotherapeutic Approach to Immunology", 1st edition, CRC Press, 2019.
3. Sam-Yellowe TY, "Immunology: Overview and Laboratory Manual", 1st edition, Springer, 2021.
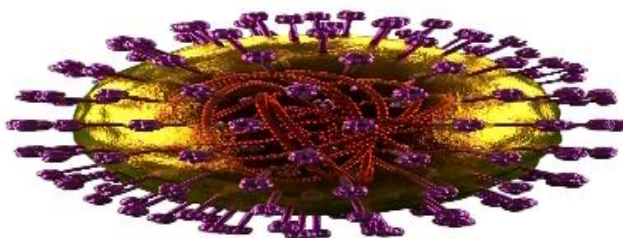

Image source: LAC Dept of Public Health - Vaccine Preventable Disease Control Program (lacounty.gov)
Image file name: VACCINE PREVENTABLE DISEASES

PREREQUISITE KNOWLEDGE: Basics of Biology

COURSE DESCRIPTION AND OBJECTIVES:
This course provides knowledge about the taxonomic features of medicinal plant families. Furthermore, the student will be trained in various herbal extraction methods, herbal formulations, validation and quality control.

MODULE-1

UNIT-1   **9L+0T+6P=15 Hours**

MEDICINAL AND AROMATIC PLANTS:
Medicinal uses of Meliaceae; Solanaceae; Lamiaceae; Euphorbiaceae; Zingiberaceae; Cultivation methods of medicinal plants - *Aloe vera*, Ashwagandha, Brahmi, Kalmegh, *Andrographis paniculata*, *Moringa oliefera, Tinispora cordifolia*, Thyme, Tulsi; Storage and protection; Marketing and utilization - export of medicinally important plants; Importance of QR codes; Plant herbarium.

UNIT-2   **15L+0T+10P=25 Hours**

AUTHENTICATION OF HERBAL PLANTS:
Identification and authentication of herbs; Different methods of processing of herbs; Methods of preparation of extracts.

PRACTICES:
- Taxonomic identification of Medicinal plants.
- Preparation of Plant Herbarium.
- Designing of QR Codes for MAPs in herbal garden.
- Identification and Authentication of herbal plants.
- Methods of preparation of Plant extracts.

MODULE-2

UNIT-1   **9L+0T+6P=15 Hours**

HERBAL COSMETICS:

Cosmetics preparations - incorporating the herbal extracts in various cosmetic formulations like skin care preparations (creams and lotions); Sunscreens and sunburn applications; Hair care preparations and beautifying preparations (lipsticks, face powders and nail polish); Skin care herbs; Herbal products

UNIT-2   **15L+10T+0P=25 Hours**

QUALITY CONTROL OF PHYTO-PHARMACEUTICALS:
Quality control of raw materials, pharmaceutical process & finished products; Validation of pharmaceutical process; Contribution of National research laboratories (CDRI, CIMAP, RRC and NBRI) in medicinal plants research.

PRACTICES:

- Preparation of herbal soaps and creams.
- Preparation of herbal Lotions and Lipsticks.
- Formulation of Bath Powders and Hair Oils using medicinal herbs.
- Case Study on validation of pharmaceutical process and analytical methods
- Report on contributions of the National research laboratories (1) CDRI, (2) CIMAP, (3) RRC and (4) NBRI in medicinal plants research.

SKILLS:

- Preparation of Plant Herbarium for authentication.
- Designing of QR Codes for Medicinal and Aromatic Plants.
- Preparation of herbal products for community health.
- Exploration of medicinally important plant compounds in plant extracts.
- Plant Herbarium and QR codes.
- Herbal formulations.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	**Apply** the physical extraction methods for processing of herbs	Apply	1	2,3,4,9,10
2	**Analyze** active compounds of herbal extracts using chromatographic methods.	Analyze	1	2,3,4,9,10
3	**Assess** the secondary metabolites in medicinal plants for healthy community.	Analyze	2	3,4,6,7,9,10
4	**Design** new formulations of herbal cosmetics with herbal infusions.	Create	2	3,4,6,7,9,10

TEXT BOOK:

1. Mukherjee PK, "Quality control and evaluation of herbal drugs: Evaluating natural products and traditional medicine", 1st edition, Elsevier, 2019.
2. Sinha RK Sinha S, "Ethnobiology: role of indigenous and ethnic societies in biodiversity conservation, human health protection and sustainable development", 1st edition, Surabhi, 2001.

REFERENCE BOOK:

1. Ramawat KG, Dass S, Mathur M, "Herbal drugs: ethnomedicine to modern medicine", 1st edition, Springer, 2009.
2. Tyagi DK, "Pharma forestry: field guide to medicinal plants", 1st edition, Atlantic, 2005.
3. Panda H, "Herbal Cosmetics Hand Book", 1st edition, Asia Pacific Business Press Inc., 2000.

Image source: Ethnobotany - Medicinal Plants - The Ethnobotanical Garden - Shroomery Message Board

Image file name: MEDICINAL PLANTS AND ETHNOBOTANY

22BT905 - VECTOR-BORNE DISEASES

Hours per week:			
L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Immunology and Immunoinformatics

COURSE DESCRIPTION AND OBJECTIVES:
This course presents the principles of transmission of human and animal pathogens by insects, mites and ticks. Covers basic arthropod biology with special attention to biological properties of vectors and their interactions with pathogens, basic components of arbopathogen disease cycles and principles of pathogen transmission dynamics. Special topics include, vector biology, traditional and next generation control strategies and venomous arthropods.

MODULE-1

UNIT-1   **9L+6T+0P=15 Hours**
Introduction to vector biology and vector-borne diseases; Brief symptomatic description of the vector-borne diseases: typhus, yellow fever, malaria, bubonic plague, dengue, hantavirus, lyme disease and west nile virus, lymphatic filariasis, Japanese encephalitis. their causative agents present in our environment.

UNIT-2   **15L+10T+0P=25 Hours**
PHYSIOLOGY OF DISEASE VECTORS:
Vector biology: introduction; Mosquitoes, ticks, triatomine bugs; Flies; Sandflies; Tsetse flies; Physiology of disease vectors and pathogen transmission cycles. Mosquitoes and malaria; Aedes spp mosquitoes and arboviruses; Sand-flies and leishmaniasis, biting midges and livestock/wildlife viruses

PRACTICES:
- Orientation and Overview on the classification and structure of Arthropods with special reference to insects
- Identification and life cycle of mosquitoes (Anophelinae and Culicinae)
- Discussion: Un hygiene increases human attractiveness to malaria mosquitoes.
- The global spread of *Aedes aegypti* and *Aedes albopictus*

MODULE-2

UNIT-1   **9L+6T+0P=15 Hours**
CONTROLLING VECTOR-BORNE DISEASES:
History of vector control: Burden of vector-borne diseases globally; Rationale behind vector control; Vector control challenges; Vector control successes. WHO global vector response: Introduction; Current vector control situation; WHO Response framework; Enabling factors.

UNIT-2   **15L+10T+0P=25 Hours**
VECTOR CONTROL:
Traditional Vector Control: Introduction; Vector control classes; Traditional vector control methods.
Modern Vector Control: Introduction, Modern Vector control methods; Successes and failures in vector control; Designing surveillance and behaviour change programmes and RCTS:

Introduction; Integrated approach in vector control; How to design and implement a vector control programme.

PRACTICES:
- Mathematical modeling of vector-borne disease dynamics
- Public health announcements
- Discussion: Leishmaniasis and Poverty
- Discussion: Meggot therapy for treating diabetic foot ulcers
- Presentation on Eradicate vector-borne diseases
- Spatial analysis of vector-borne disease dynamics
- Machine Learning model to predict the recurrence of seasonal Vector-Borne diseases

SKILLS:
- Classifying insect vectors of tropical region.
- Predicting the life cycles of insect vectors based on seasons.
- Enlisting the diseases due to seasonal born vectors.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	**Apply** the distribution of vector arthropods and diseases transmitted.	Apply	1	1,4,7,9,10
2	**Analyze** the lifecycle of mosquitoes, sandflies, tsetse flies, triatoma bugs and ticks	Analyze	1	2,4,9,10
3	**Evaluate** and understand the control methods used against these vectors	Evaluate	2	3,4,5,9,10
4	**Evaluate** how to implement control strategies most effectively and how to design robust studies to collect scientifically rigorous data	Evaluate	2	3,5,6,9,10

TEXT BOOKS:
1. Brij Kishore Tyagi, Dharumadurai Dhanasekaran, "Microbial control of vector-borne diseases" 1st edition, CRC Press, 2018.
2. Graham Matthews, "Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases" 1st edition, Wiley-Blackwell, 2012.

REFERENCE BOOKS:
1. Kenneth J. Linthicum, Assaf Anyamba, Jean-Paul Chretien, Jennifer Small, "Vector Biology, Ecology and Control" 1st edition, Springer Netherlands, 2010.
2. Willem Takken, Constantianus J. M. Koenraadt, "Ecology of parasite-vector interactions" 1st edition, Wageningen Academic Publishers, 2013.
3. Pratt HD, Moore CG. Mosquitoes of Public Health Importance and Their Control, CDC, 1993.
4. Online course conducted by London School of Hygiene and Tropical medicine & Online Course on Zoonotic diseases and their control.
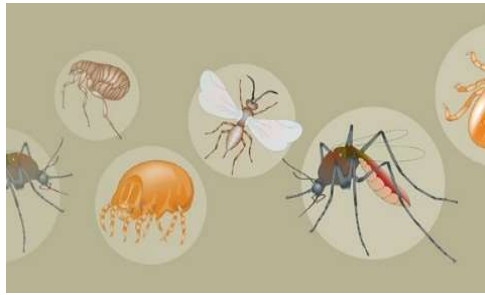
Image source: https://www.nature.com/collections/lbfsgzmyns/Image
file name: VECTOR BORN DISEASES

MINOR ON ENVIRONMENTAL MANAGEMENT AND TECHNOLOGY
Offered by Department of Civil Engineering

Environmental Management and Technology (EMT) is a very important criterion of allocating natural and man-made resources so as to make optimum use of the environment in satisfying not only the present basic human needs but of the coming generations also and it involves environmental planning, conservation of resources, environmental status evaluation, and environmental legislation and administration. The uniqueness of the Minors program is task-specific, where the students learn on implementation, monitoring and auditing; on practice and coping with real-world issues, rather than theoretical planning. During the last three decades much awareness has been developed regarding environmental protection and quality of life. The dictionary of environment is renewed regularly with new terminologies like air pollution control, environmental auditing, environment-friendly products, industrial waste management, environmental impact assessment, industrial safety, etc. In addition, these courses convert education in a way that would utilize knowledge and technology both together in a sustainable way and its make the learning resource a lot more powerful. It offers better community acceptance, a strong impact and even quality result because of which, students will get more chances/possibilities to work in multi-disciplinary areas as EMT is important forever in view of sustainable development.

Choosing this minor helps the students to explore the environmental problems, provide information about long-term and short-term policies of sustainable development, new technologies available and strategies for the improvement of quality life. The following is the list of courses offered in this stream.

Course Code	Course Title	L	T	P	C
22CE901	Air pollution & Control	3	2	0	4
22CE902	Environmental Impact Assessment	3	2	0	4
22CE903	Principles of Industrial waste Management	3	2	0	4
22CE904	Industrial Safety	3	2	0	4
22CE905	EIA for Building Technology	3	2	0	4
22CE916	Project Work	0	2	6	4

22CE901 - AIR POLLUTION AND CONTROL

Hours per week:			
L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Environmental Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

This course aims to provide the interested with a variety of perspective on the air pollution issues of both ambient and indoor air pollution. And to present the problems of air pollution as a potpourri of scientific, human, ecological, social, economic, political, legal and medical disciplines.

MODULE - 1

UNIT-1   **12L+2T+0P= 14 Hours**

AIR POLLUTION:

Introduction, Definition, Sources, classification of air pollutants, Natural contaminants, Gases Primary and secondary air pollutants. Stationary and mobile sources. Meteorology: Meteorology and air pollution, primary parameters – Wind direction and speed, temperature, atmospheric stability, mixing height, secondary parameters – precipitation, Humidity, solar radiation, visibility. Methods of measurement of meteorological variables.

UNIT-2   **12L+14T+0P=26 Hours**

INDUSTRIAL PLANT LOCATION AND PLANNING:

Introduction, Factors to be considered for industrial plant location, Existing levels of air contaminants, Potential effects on surrounding area, meteorological factors and climate, topographical features, planning and zoning, City planning.

PRACTICES

- Concept of Natural contaminants
- Primary and secondary air pollutants.
- Analysis of Stationary and mobile sources
- Meteorology and air pollution
- Existing levels of air contaminants
- Analysis of planning and zoning.

MODULE - 2

UNIT 1   **12L+2T+0P= 14 Hours**

PLUME BEHAVIOUR:

Single stack and multiple source pollution, wind rose, Stack effluent dispersion theories, effect of dilution, plume rise. Dispersion model: wind tunnel method. Stack height. Effects of air pollution on human health, plants, animals, and properties. Major air pollution disasters: Meuse valley (Belgium), Donora (USA), London, Bhopal gas tragedy.

UNIT 2   **12L+14T+0P=26 Hours**

SAMPLING PROCEDURES AND CONTROL:

Classification of sampling methods, instruments for sampling waste gases and for atmospheric sampling, duration and sampling sites, sampling methods, high volume sampler and respirable dust sampler. Air pollution due to automobiles: exhaust emissions; crank case emission, evaporative emissions, air-fuel ratio. Spark timing, control of exhaust emissions. Air quality and emission standards, air pollution legislations and regulations.

PRACTICES:
- Single stack and multiple source pollution
- Effect of dilution in air pollution
- Major air pollution disasters
- Classification of sampling methods.
- Air pollution due to automobiles.

SKILLS:
- The variety of perspective on the air pollution.
- Analysis of ambient and indoor air pollution.
- Air pollution control strategies
- General performance of present the problems of air pollution.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

Cos	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Assess the quality of air and evaluation the impact on local and global effects of air pollution.	Apply	1	1, 2, 6,7,12
2	Apply and relate the significance of various air pollution dispersion models	Apply	1, 2	2, 3, 5,7,12
3	Distinguish the levels of air pollutants and its measurement techniques	Analyze	1, 2	2, 5,7, 12
4	Analysis the importance of the various types of air pollution control equipment	Analyze	1, 2	1, 2,7,12

TEXT BOOKS:
1. MN Rao & HVN Rao. "Air pollution" Tata McGraw-Hill Publishing Company Limited. New Delhi.
2. Y. Anjaneyulu, "Text book of Air Pollution and control Technologies", Allied Publishers (P) Limited, New Delhi.

REFERENCE BOOKS:
1. Wark Kenneth and Warner C.F, 2009, "Air pollution its origin and control". Harper and Row Publishers, New York.
2. Rao C.S., 2007, "Environmental pollution control engineering", New age international Ltd, New Delhi.

Image Source Link: https://www.apctechnologies.net/blog/effective-and-affordable-air-pollution- control/

Image:

22CE902 - ENVIRONMENTAL IMPACT ASSESSMENT

Hours per week:

L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Environmental Studies.

COURSE DESCRIPTION AND OBJECTIVES:

The course is designed to know the various environmental aspects like assessment of soil, surface water environment, impact of air pollution, which are essential to consider before establishment of any civil engineering projects at a particular location. It also deals with different legislative acts and environment audits regarding selection of location of the project.

MODULE - 1

UNIT-1   **12L+2T+0P= 14 Hours**

BASIC CONCEPTS OF EIA:

Initial Environmental Examination; Elements of EIA; Factors affecting EIA; Impact evaluation and analysis; Preparation of Environmental Base map; Classification of Environmental parameters. EIA Methodologies; Introduction; criteria for the selection of EIA Methodology; EIA Methods: Ad-hoc methods, Matrix methods, Network method, Environmental media quality index method; Overlay methods; Cost/benefit Analysis

UNIT-2   **12L+14T+0P=26 Hours**

IMPACT OF DEVELOPMENTAL ACTIVITIES AND LAND USE:

Introduction and Methodology for the assessment of soil and ground water; Delineation of study area; Identification of activities. Procurement of relevant soil quality; Impact prediction; Assessment of Impact significance; Identification and Incorporation of mitigation measures.

PRACTICES:

- Concept of Methodology for the assessment.
- Identification of activities.
- Analysis of Delineation of study area.
- Impact prediction.
- Identification and Incorporation of mitigation measures.

MODULE - 1

UNIT-1   **12L+2T+0P= 14 Hours**

EIA IN SURFACE WATER, AIR AND BIOLOGICALENVIRONMENT:

Methodology for the assessment of Impacts on surface water environment; Air pollution sources; Generalized approach for assessment of Air Pollution Impact. Assessment of Impact of Development activities on vegetation and wildlife; Environmental Impact of Deforestation; Causes and effects of deforestation. Coastal regulations and Use of R.S and GIS

UNIT-2   **12L+14T+0P=26 Hours**
ENVIRONMENTAL AUDIT AND ENVIRONMENTAL LEGISLATION:
Objectives of Environmental Audit; Types of Environmental Audit; audit protocol; stages of Environmental Audit; On-site activities; Evaluation of Audit data and preparation of Audit report. The Environmental Pollution Act, The Water Act; The Air (Prevention and Control of Pollution) Act; Wild life protection Act. Case Studies and preparation of Environmental Impact Assessment statement for various industries.

PRACTICES:
- Environmental Audit.
- stages of Environmental Audit
- Evaluation of Audit data and preparation of Audit report
- The Environmental Pollution Act
- Environmental Impact Assessment statement for various industries

SKILLS:
- Impact Assessment of pollution for developmental projects
- Analysis of assessment of soil, surface water environment
- Design of EIA for any project
- General performance of EIA reports.
- Environmental Auditing

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to

| Cos	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Assess the environmental attributes to be considered for the EIA study	Apply	1	1, 2,7,12
2	Distinguish the objectives of the EIA studies	Analyze	1, 2	2,7,12
3	Analysis and Identify the methodology to prepare rapid EIA	Analyze	1, 2	1, 2,7,12
4	Prepare EIA reports and environmental management plans	Creating	1, 2	2,5,7,12

TEXT BOOKS:
1. Y. Anjaneyulu; "Environmental Impact Assessment Methodologies", Vol.-I, 2nd ed., B.S. Publication, Sultan Bazar, Hyderabad, 2007.

REFERENCE BOOKS:
1. J. Glynn and Gary W. Hein Ke, 1998, "Environmental Science and Engineering", Vol-I, 3rd ed., Prentice Hall Publishers.
2. K. Dhameja, S.K. Kataria, 1998, "Environmental Science and Engineering", Vol-II, 2nd Edition, Suresh & Sons Publications, New Delhi, 2001.3. Dr. H.S. Bhatia, "Environmental Pollution and Control", Vol-I, 4th ed., Galgotia Publications Pvt. Ltd.

Image Source Link: https://www.indiamart.com/technogreen-environmental-solutions/environment-impact-assessment.html

Image:
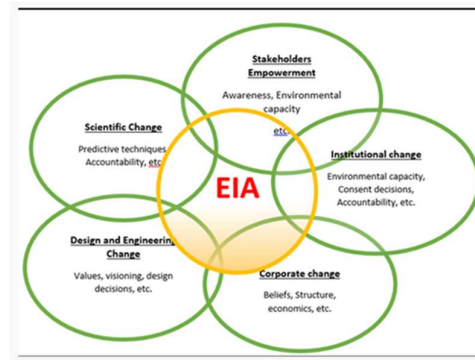
22CE903 - PRINCIPLES OF INDUSTRIAL WASTE MANAGEMENT

	Hours per week:		
L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Environmental Engineering/Environmental Studies.

COURSE DESCRIPTION AND OBJECTIVES:

The course has been designed to improve the understanding about different industrial waste water treatment technologies. In addition, the students will be able to describe the physical, chemical, and biological processes necessary for designing and managing primary, secondary, tertiary and advanced wastewater treatment processes and solids handling systems.

MODULE - 1

UNIT-1   **12L+2T+0P= 14 Hours**

PROCESS OF INDUSTRIAL WASTES:

Introduction, Principles of industrial waste management, sources of pollution, physical, chemical, organic and biological properties, effects of waste water on self-purification capacity of streams, land environment and human health, characteristics of treatment plant effluents, Effect of waste water, Aerobic treatment studies in continuous and semi-continuous reactors. Anaerobic treatment, studies, Nitrogen and Phosphorus removal.

UNIT-2   **12L+14T+0P=26 Hours**

PROCESS OF INDUSTRIAL WASTES:

Activated sludge process; trickling filter; sludge digestion units; Aerated lagoons; Stabilization ponds (oxidation ponds); oxidation ditches, Non-Conventional method of wastewater treatment: Wetlands, Rotating Biological contactor; Anaerobic filter

PRACTICES:

- Concept of Principles of industrial waste management
- Physical, chemical, organic and biological properties
- Analysis of various Industrial effluents
- Characteristics of treatment plant effluents
- Conventional method of wastewater treatment

MODULE - 2

UNIT-1   **12L+2T+0P=14 Hours**

INDUSTRIAL WASTE TREATMENT:

Waste reduction pre-treatment of wastes, collection and segregation of wastes, reduction in volume and strength neutralization; equalization; proportioning.

UNIT-2   **12L+14T+0P=26 Hours**

PROCESSES, CHARACTERISTICS, TREATMENT AND DISPOSALOFTHE INDUSTRIES:

Sugar Industry, Dairy Industry, Distillery, Paper Industry, Tannery's, Textiles Sheet, Fertilizer Industry, Oil refinery and Petrochemicals.

PRACTICES:

- Waste reduction pre-treatment of wastes
- reduction in volume and strength process
- Processes, Characteristics of industrial wastes
- Treatment and disposal of the Industries waste

SKILLS:

➢ Concept of Industrial effluents
➢ Analysis of different industrial waste water.
➢ Design of treatment systems
➢ General performance of treatment process
➢ Advanced wastewater treatment processes

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

| Cos	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Assess the characteristics of the Industrial and biological wastes	Apply	1	1, 2,7,12
2	Design of various treatment methods for industrial wastewaters	Analyze	1, 2	2, 5,7,12
3	Analysis and Identify the treatment technologies	Analyze	1, 2	1, 2,7,12
4	Create reports related to prevention and control of industrial effluents and hazardous wastes	Create	1, 2	3, 5,7,12

TEXT BOOKS:

1. M.N. Rao and A.K. Datta, Industrial Waste Management;
2. Metcalf and Eddy; 1995, "A waste water Engineering Treatment, disposal and Reuse", Tata Mc. Graw-Hill Co., 3rd Edition.

REFERENCE BOOKS:

1. Standard methods for examination of Water and waste water, APHA, American Water Work Association, Water pollution control federation, New York.
2. Waste and waste water technology, Mark, JH. John Wiley and Sons, New York.

Source Link: https://sisu.ut.ee/waste/book/21-main-principles-waste-management
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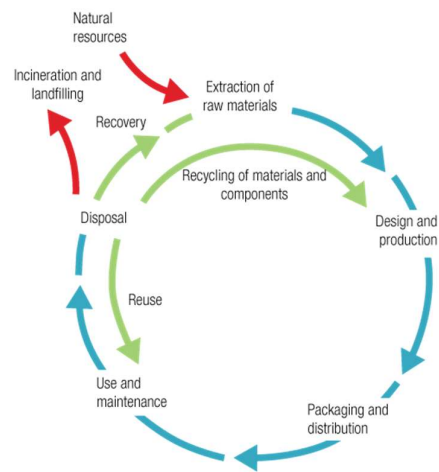
22CE904 - INDUSTRIAL SAFETY

Hours per week:

L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Environmental Engineering and Environmental Studies.

COURSE DESCRIPTION AND OBJECTIVES:

The course has been designed to impart knowledge on different facets and aspects of engineering systems safety, focusing on tools, techniques and methodologies needed for prevention of occurrences of nsafe operations and accidents under different industrial settings and integrating safety with other operational goals such as quality and reliability.

MODULE - 1

UNIT-1   **10L+2T+0P= 12Hours**

SAFETY:

Introduction, importance of the safety, Principles of industrial safety, definition –Accident, Incident, Hazard, explosion, Contamination, Fire, protection, housekeeping, safe measures. Safety training and education.

UNIT-2   **14L+14T+0P=28 Hours**

OCCUPATIONAL HEALTH:

Concept of health and occupational health, Spectrum of health, Occupational and work related diseases, Levels of prevention, History of occupational health, Characteristics of occupational diseases, Essentials of occupational health service, personal protective equipment's (respiratory and non-respiratory).

PRACTICES:
- Concept of importance of the safety
- Principles of industrial safety
- Analysis of EHS
- Safety training and education
- Health and occupational health
- Analysis of Essentials of occupational health service.

MODULE-1

UNIT-1:   **10L+2T+0P= 12Hours**

Hazards in work places – Safety in Process plants: Nature and types of work places, type of Hazards, hazards due to improper housekeeping, workers exposure to hazardous chemicals, Physical and chemical properties of chemical leading to accidents like fire, explosion, ingestion and inhalation – atmospheric pollution, dangers of dusts, fumes, vapours in work spots., Noise and Vibration hazards. Case studies - Hazards peculiar to the following industries: Thermal Power plants, Steel industry, Mining Industry, Fertilizers.

UNIT-2   **14L+14T+0P=28 Hours**

CONTROL OF FIRE HAZARDS & SAFETY MANAGEMENT:

Factors contributing towards fire. Chemistry of fire. Classification of fires. Common causes of industrial fires. Determination of fire load. Fire resistance of building materials. Design of

building plant, exits, etc. for fire safety. Prevention of fire. Portable extinguishers. Water systems, carbon-di-oxide systems. Foam extinguisher system. Dry chemical extinguishing system. Industrial fire detection and alarms. Sprinkle systems.

Management: Concept, definition, nature and importance, Role and functions of a manager, Elements and functions of Management.

Management Principles: Authority, responsibility & power of management.

PRACTICES:

- Safety in Process plants
- Hazards due to improper housekeeping
- Physical and chemical properties of chemical leading to accidents
- Factors contributing towards fire.
- General principles of Management in EHS

SKILLS:

- The engineering systems safety.
- Analysis of prevention of occurrences of unsafe operations and accidents.
- Accidents under different industrial settings.
- General performance of EHS
- Design of different operational goals such as quality and reliability.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

COs	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Assess the best safety practices in a variety of workplaces of industry	Apply	1	1, 2,7,12
2	Apply risk management principles to manage the hazards	Analyze	1, 2	2, 5,7,12
3	Evaluation of information and data to identify trends and issues in the workplace	Analyze	1, 2	2,7,11,12
4	Create reports of environment, health and safety (EHS).	Create	1, 2	2, 3, 5,7,12

TEXT BOOKS:

1. R.K. Jain and Sunil S. Rao , 2012, "Industrial Safety, Health and Environment Management Systems", Khanna publishers, New Delhi.
2. Metcalf and Eddy; 2005, "A waste water Engineering Treatment, disposal and Reuse", Tata Mc. Graw-Hill Co., 3rd Edition.

REFERENCE BOOKS:

1. Frank P. Lees, 2012, "Loss of prevention in Process Industries", Vol. 1 and 2, Butterworth Heinemann Ltd., London.
2. Grimaldi and Simonds, 2005, "Safety Management", AITBS Publishers, New Delhi
3. Herman Koren and Michel Bisesi, 1991, "Handbook of Environmental Health and

Safety" Jaico Publishing House, Delhi.

Source Link: https://social-innovation.hitachi/en-in/knowledge-hub/viewpoint/industrial-safety-monitoring-systems/

Image:

22CE905 - EIA FOR BUILDING TECHNOLOGY

PRE-REQUISITE KNOWLEDGE: Environmental Engineering.

COURSE DESCRIPTION AND OBJECTIVES:
To identify and predict the impact of a proposed project on bio geo physio chemical environment and human health so as to recommend appropriate legislative measures, programs and operational procedures to minimise the impact and ensures the potential problems are foreseen and addressed at an early stage in the project planning and management.

MODULE – 1

UNIT-1   10L+4T+0P = 14 Hours

INTRODUCTION TO EIA:

Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring.

UNIT-2   14L+12T+0P = 26 Hours

PRACTICAL APPROACH FOR EIA:

Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements. Identifying the Key Issues: Key Elements of an Initial Project Description and Scoping, Project Location (s), Land Use Impacts, Consideration of Alternatives, Process selection: Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts.

PRACTICES:

- Concept of EIA.
- Components of EIA.
- Analysis of EIA Process.
- Key Elements in Project for EIA Report
- Socio Economic Impacts due installation of new project.

MODULE – 2

UNIT-1   10L+4T+0P = 14 Hours

EIA METHODOLOGIES:

Global Environmental Issues, EIA Methodologies: Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods.

PRACTISE ON EIA REPORT:

Introduction: The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

PRACTICES:
- Concept of global environmental issues.
- Indian policies and regulations for EIA.
- EIA Methods.
- List out the projects need environmental clearances.
- List out the composition for Expert committee for EIA.

SKILLS:
➢ To prepare the EIA Report
➢ To prepare the EMP report.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

Cos	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Analyze the facts, classification, grouping, significance and criteria to determine the methods of impact.	Analyze	1	1, 2
2	Predict and analyse the impacts of development projects on air and water quality, their affects and come up with the conceptual approach to address impacts on air and water.	Analyze	1	1, 2, 6
3	Analyze the impacts of development projects using various EIA methodologies.	Analyze	2	1, 2
4	Design the development of EIA and its importance.	Create	2	1, 2, 6

TEXT BOOKS:
1. Anjaneyulu.Y., and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.
2. Canter, L.W., Environmental Impact Assessment, Mc Graw Hill Pub. Co., 1997.

REFERENCE BOOKS:

1. Problems, John Wiley & Sons, 2003.
2. Hosetti, B. B., Kumar Eds, A., Environmental Impact Assessment and Management, Daya, Publishing House, 1998.

Source Link: https://www.ecosens.ch/en/environmental-impact-assessment.html

Image:

MINOR ON GEOSPATIAL DATA SCIENCE AND TECHNOLOGY

Offered by Department of Civil Engineering

In the era of Information Technology with rapid advancement in computing, decision making has become more informed and scientific and this field of Geospatial Technology has emerged strongly with diverse applications. The role of geospatial technologies is getting pronounced for the transformation of the society with equitable distribution of sources and establishing social justice eventually enhancing quality of life into the society. They are modern means for optimizing resources precisely leading to improvement in accuracy and also increasing integration of digital survey data with other technologies.

Geospatial technology is a term used to describe the range of modern tools contributing to the geographic mapping and analysis of the Earth and Human Societies. Geospatial Technologies involve GIS, GPS, & RS. This technology offers radically different way in which one can produce and use maps required to manage our communities and industries. This minor will useful for students to get the multi-disciplinary exposer and opportunities to analyzie the geospatial data in various departments to develop different applications. The following is the list of courses offered in this minor stream.

Course Code	Course Title	L	T	P	C
22CE911	Geospatial Data Analysis & Modelling	3	2	0	4
22CE912	Geospatial Data Science for Natural Resource Management	3	2	0	4
22CE913	Geospatial Data Science for Environment Management	3	2	0	4
22CE914	Geospatial Data Science for Water Resource Management	3	2	0	4
22CE915	Geospatial Data Science Applications	3	2	0	4
22CE916	Project Work	0	2	6	4

22CE911 - GEOSPATIAL DATA ANALYSIS & MODELLING

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an introduction to Geospatial data analysis & modeling - a set of hardware, software, and methods for the analysis, modelling, and display of geographic information, used to solve complex spatial planning problems. Specific Geospatial methods are covered for use in a variety of applications areas and disciplines, including cartography, demographics, analysis, spatial statistics and modeling.

MODULE - 1

UNIT-1   **8L+4T+0P = 12 Hours**

FUNDAMENTALS OF GIS:

Map – scale, projection and symbolism. GIS - Introduction, definition and terminology, categories, components, fundamental operations, functional elements. Data structures, data models, GIS data, acquisition, input, storage, output generation. Data preprocessing, database management, integrated analysis of spatial and attribute data.

GIS Spatial Analysis: Introduction, defining spatial objects - point, line and area objects based on their attributes, higher level point, line and area objects.

Measurement: Measuring length of linear objects, measuring polygons, measuring shape, measuring distance. Classification – Principles, Neighborhood functions, Polygonal neighborhoods, Buffers.

UNIT-2   **8L+12T+0P = 20 Hours**

STATISTICAL SURFACES:

Surface mapping, sampling the statistical surface, Digital Elevation Model (DEM). Interpolation-linear and non-linear, uses and problems. Terrain reclassification –steepness of slope, aspect, shape or form. Discrete surfaces - dot distribution maps, choropleth maps.

Spatial Arrangement: Spatial Arrangement -Point patterns, Theissen Polygons, Area patterns, Linear patterns, Directionality of Linear and Areal objects, Connectivity of Linear objects, Routing and allocation.

PRACTICES:
- Concept of GIS.
- Analysis of database management.
- Analysis of Data preprocessing.
- Functional elements of GIS
- Spatial Measurements

MODULE - 2

UNIT-1   **10L+2T+0P = 12 Hours**

Overlay Analysis: Cartographic overlay, point-in-polygon and line-in-polygon operations, Polygon overlay, Automating point-in-polygon and line-in-polygon procedures in Raster, Automating Polygon overlay in Raster, Automating vector overlay, types of overlay.

Data Modelling: The state of GIS for Environmental Problem Solving, A Perspective on the State of Environmental Simulation Modeling, GIS and Environmental Modeling, The Role of Software Venders in Integrating GIS and Environmental Modeling, Cartographic Modeling, Scope of GIS and relationship to environmental modeling, data models and data quality.

UNIT-2   **8L+12T+0P = 20 Hours**

Integrated Modelling using GIS: Hydrological Modeling - water quality modeling, watershed management and modeling, saltwater intrusion models. Land-surface-subsurface Process Modeling - pipeline alignment studies, solid and hazardous waste disposal site selection, zoning atlas for industrial siting, environmental information system development. Ecosystem modeling, risk and hazard modelling.

GIS data analysis and Modelling Lab:

Spatial data analysis using ArcView, Map Composition and Output Generation using Arc View GIS software, Alignment survey by handheld GPS, Processing of GPS survey data with GIS software, Plot by Total Station Survey in field, Data conversion from AutoCAD into ArcGIS., Open source GIS., Integration of Spatial and Non Spatial Data, Datum and Projection, Layout Preparation in Arc View.

PRACTICES:
- Concept of GIS Overlay Analysis
- GIS Data Modelling.
- Integrated Modelling using GIS
- GPS data Processing.
- Integration of Spatial and Non Spatial
- Industrial siting.

SKILLS:
- ➢ Geospatial data analysis & modeling technique
- ➢ Geospatial data analysis & modeling Identification
- ➢ Geospatial data analysis & modeling from satellite images.
- ➢ Geospatial data analysis & modeling Develop different Application using images.
- ➢ Develop various Information systems using Geospatial data analysis & modeling

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

| Cos	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Clasify basic concepts of geospatial data analysis & modeling	Analyze	1	5, 6, 10
2	Examine the elements of Geospatial data analysis & modeling	Analyze	1,2	1, 2, 12
3	Explain the basic components Geospatial data analysis & modeling	Evaluate	1,2	1, 12
4	Describe the Geospatial data analysis & modeling and Explain the different applications of Geospatial data analysis & modeling	Create	2	1, 2, 5, 12

TEXT BOOKS:
1. Fundamentals of GIS by MICHAEL N DEMERS. Published By john Wiley & Sons Inc.1998
2. Environmental Modelling with GIS, Michael F. Goodchild, Bradley O. Parks, Louis T. Steyaert, 2005.

REFERENCE BOOKS:
1. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.
2. Geographical Information Systems by David Martin,2001.

Source Link: https://eos.com/blog/spatial-analysis/
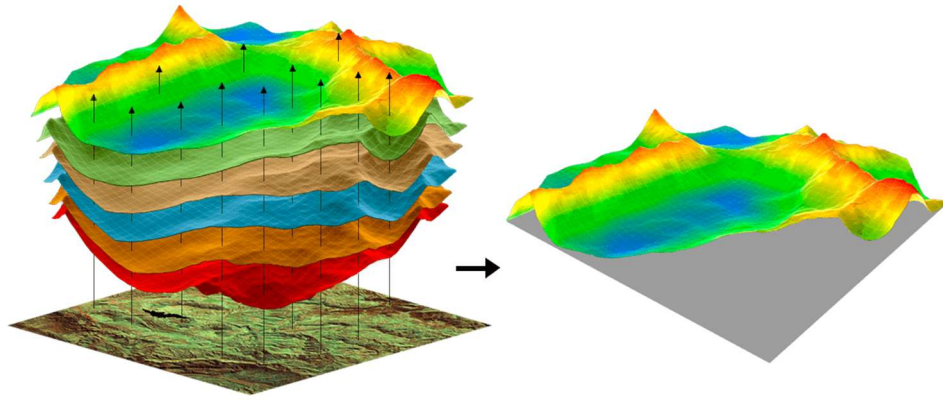
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22CE912 - GEOSPATIAL DATA SCIENCE FOR NATURAL RESOURCES MANAGEMENT

Hours per week:			
L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Geospatial data Analysis and Design.

COURSE DESCRIPTION AND OBJECTIVES:
This course provides an introduction to geospatial data for natural resources management - a set of hardware, software, and methods for resources management, analysis, modelling, and display of geographic information, used to solve complex geospatial data problems. Specific geospatial methods are covered for use in a variety of natural resources management applications and disciplines, analysis studies, spatial statistics and natural resources management applications. Industry standard Geospatial software tools are used to apply these methods.

MODULE 1

UNIT-1   **10L+4T+0P = 14 Hours**
LAND RESOURCES:
Land evaluation and suitability studies by Remote sensing and GIS. Techniques of land use / land cover map preparation. Land use / land cover mapping and planning.
Municipal GIS: Geomatics in Solid and Hazardous waste disposal site selection, Environmental Information System Development for municipalities: Case studies
Geosciences: Role of Remote sensing and GIS in geological studies and case studies.
Water Resources: Ground water exploration and targeting. Watershed characteristics, watershed management and Integrated approach for sustainable planning. Water quality modeling.

UNIT-2   **14L+12T+0P = 26 Hours**
AGRICULTURE:
Soil and altitude, Soil and aspect, Soil and slopes, Soil landscapes, Soil erosion modeling. Crop type classification, area estimates, and spectral response of different crops. Crop diseases and Assessment, Crop and Water management and monitoring. Advances in Crop monitoring.

PRACTICES:
- Concept of Land resources and Agriculture.
- Environmental Information System
- Methods of Ground water exploration
- Develop the Crop classification.
- Analysis of Advances in Crop monitoring.

MODULE -2

UNIT-1   **10L+4T+0P = 14 Hours**
FORESTRY:
Survey and mapping of forest cover, Forest change detection, Forest damage assessment and Forests monitoring, Land evaluation for forestry.

Ecosystem Modeling: Spectral response of vegetation and mapping, Ecosystem Analysis, Environmental impact analysis and monitoring, Ecosystem modeling, Wetland mapping. Spatial Models of Ecological Systems and Process.

UNIT-2   **14L+12T+0P = 26 Hours**
Disaster Management: Introduction and Overview- Natural and man made hazards – land slides- volcanoes- floods and famines- earth quakes- forest fires Human Induced disasters- industrial disasters- dams- constructional and others.

PRACTICES:
- Concept of Land evaluation and Ecosystem modeling.
- Environmental impact analysis and monitoring.
- Methods of vegetation mapping.
- Develop the Ecosystem modeling.
- Analysis of Spatial Models of Ecological Systems and Process.

SKILLS:
- Image Interpretation technique for geospatial data for natural resources management
- Identify the outcome from geospatial data for natural resources management.
- Identify the different geospatial data for natural resources management.
- Develop different natural resources management Application using images.
- Develop various natural resources management Information systems using software.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

Cos	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Simplify basic concepts of geospatial data for natural resources management	Analyze	1	5, 6, 10
2	Examine the elements of geospatial data for natural resources management	Analyze	1,2	1, 2, 12
3	Assess the basic components and data type of geospatial data for natural resources management	Evaluate	1,2	1, 12
4	Develop the data quality of geospatial data for natural resources management and Explain the different applications of geospatial data for natural resources management	Creating	2	1, 2, 5, 12

TEXT BOOKS:

1. Environmental Modelling with GIS, Michael F. Goodchild, Bradley O. Parks, Louis T. Steyaert ,2008
2. Manual of Geospatial Science and Technology Edited by John. D. Bossler, Taylor And Francis, London,2009

REFERENCE BOOKS:

1. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.
2. Geographical Information Systems by David Martin,2001
3. RS in Geology by Siegal,2004
4. RS in Forest Resources by John. A. Howard, Chapman and Hall, 2018.

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Image:

22CE913 - GEOSPATIAL DATA SCIENCE FOR ENVIRONMENTAL MANAGEMENT

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Geospatial Data Science For Natural Resources Management.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an introduction to Geographical spatial data for environmental management –a set of hardware, software, and methods for the capture, storage, management and display of geospatial data, used to solve complex environmental management spatial planning problems including demographics, site selection, analysis studies applications, spatial statistics, and environmental applications. Industry standard Geospatial software tools are used to apply these methods.

MODULE - 1

UNIT-1   **10L+4T+0P = 14 Hours**

Forest Resources Management: Geomatics in forestry, forest cover mapping and change detection, forest inventory and stock mapping, dynamics of forest ecosystem and forest canopy, forest damage assessment, parameters of forest inventory, development of working plan, forest management information system (FMIS), forest fire forecasting and risk area mapping, biodiversity characterization, wildlife habitat mapping.

Watershed Management: Introduction and concepts of watershed, role of remote sensing and GIS database for watershed management, objectives of watershed management, Watershed characteristics, research approach, thematic mapping for a model watershed, watershed management for sustainable development.

UNIT-2   **14L+12T+0P = 26 Hours**

Water Quality Mapping and Modeling: Geoinformatics for water resources development and management, ground water exploration and targeting using RS and GIS, water quality management case studies – groundwater and surface water quality mapping and salt water intrusion modeling.

PRACTICES:

- Concept of forest and water resources.
- Quality of water
- Physic chemical Analysis of water quality.
- Develop the forest management information system (FMIS).
- Analysis of wildlife habitat mapping.

MODULE - 2

UNIT-1   **10L+4T+0P = 14 Hours**

Solid Waste Management: Introduction, types and classification of solid waste, impacts of solid waste, physical and chemical characteristics of solid waste, factors affecting solid waste generation rates,

collection and transportation systems, solid waste sampling techniques, types, merits and demerits of solid waste disposal methods, hierarchy of solid waste management, disposal site identification.

Natural Disaster Management: Introduction, types of landslides, common features of landslides, causes of landslides and related phenomena, landslide analysis, remote sensing for landslide mapping, hazard mapping of landslides.

UNIT-2   **14L+12T+0P = 26 Hours Urban**

Planning and Management: Introduction, geoinformatics in urban planning, issues in urban planning, urban growth management, urban sprawl assessment, urban land use and infrastructure, urban transport network identification and mapping, urban city guide map change detection and updation, pipeline alignment studies, Land evaluation and suitability studies, Land use/Land cover mapping and planning.

PRACTICES:
- Classification of solid waste
- Solid waste disposal methods
- Remote sensing for landslide mapping
- Issues in urban planning
- Urban city guide map change detection and updation.

SKILLS:
- Environmental geospatial data Interpretation technique.
- Identify the outcome from environmental geospatial data.
- Develop various environmental geospatial information systems using software.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

| Cos	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Analyze the basic concepts of environmental geospatial data	Analyze	1	5, 6, 10
2	Examine the elements of geospatial data interepretation	Analyze	1,2	1, 2, 12
3	Evaluate the basic components environmental geospatial data	Evaluate	1,2	1, 12
4	Estimate the data quality and different environmental geospatial data applications	Create	2	1, 2, 5, 12

TEXT BOOKS:

1. Geoinformatics for Environmental Management by Anji Reddy, M.2015
2. Introduction to Environmental Remote Sensing by Barrett, E.C.2010

REFERENCE BOOKS:

1. Remote Sensing and Tropical Land Management by Eden, M.J., Parry I.T.2015
2. Remote Sensing and Image Interpretation by Lillesand and Kiefer.2017
3. Remote Sensing in Hydrology by Engman, 2016.

Source Link: https://www.supermap.com/en-us/case/?71_698.html
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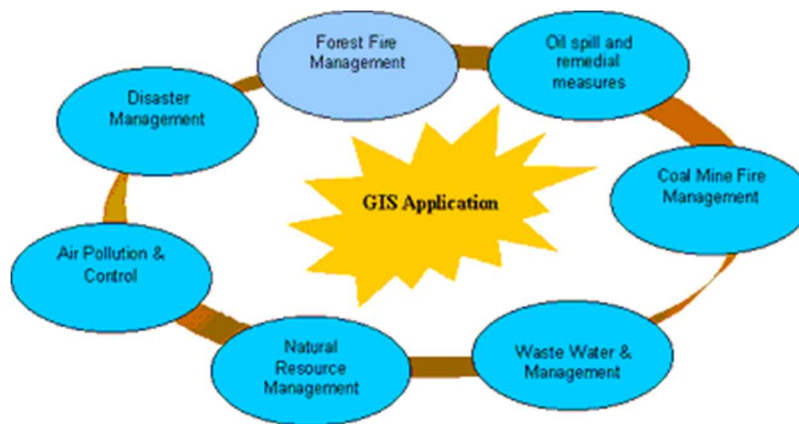
22CE914 - GEOSPATIAL DTA SCIENCE FOR WATER RESOURCES MANAGEMENT

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Geospatial Data Science For Environmental Management

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an introduction to Geospatial data science - a set of data management used to solve complex water resources spatial planning problems. Specific Geospatial methods are covered for use in a variety of applications areas and disciplines, spatial statistics, and water resources management applications. Industry standard Geospatial software tools are used to apply these methods.

MODULE - 1

UNIT-1   **10L+4T+0P = 14 Hours**

Fundamentals: Internal Constitution of the Earth. Basic Concepts of Geologic Structures Governing Occurrence and Movement of Ground Water, Ground Water in Igneous, Metamorphic and Sedimentary Rocks, Hydrogeological Methods of Exploration

Watershed Management: Objectives of Planning Watershed Projects, Guidelines for Project Preparation, Watershed Delineation, Codification, Resources Surveys, Hydrological, Soil, Vegetative and Land Use Surveys, Socio-Economic Surveys, Water and Soil Conservation Works, People's Participation and Constraints, Participatory Rural Appraisal in Watershed Programme, Community Mobilization & Participatory Management, Peoples Institutions, Capacity Building.

UNIT-2   **14L+12T+0P = 26 Hours**

Rain Water-Harvesting Methods: Methods of Rainwater Harvesting from Roof Tops, Purification Techniques for Direct use, Harvesting of Surface Runoff, Climatic Changes, Its Effects on Water Resource

PRACTICES:

- Basic Concepts of Geologic Structures
- Hydrogeological Methods of Exploration
- Planning of Watershed Projects
- Rural Appraisal in Watershed Programme
- Community Mobilization & Capacity Building.

MODULE – 2

UNIT-1   **10L+4T+0P = 14 Hours**

Wetlands: Introduction, Definition, Classification, Delineation, Identification Methods, Importance Of Wetlands, Human Impacts, Wetland Protection, Mitigation. Wetland Management:

Designed Ecosystem, Water and Treated Wastewater Recycling and Reuse, Soil Filters, Constructed Wetlands & Water Supplies.

Introduction, concept of watershed, need for watershed management, concept of sustainable development, Hydrology of small watersheds, Principles of soil erosion, causes of soil erosion, types of soil erosion, estimation of soil erosion from small watersheds Control of soil erosion, methods of soil conservation – structural and non-structural measures.

UNIT-2   **14L+12T+0P = 26 Hours**

Principles of water harvesting, methods of rainwater harvesting, design of rainwater harvesting structures, Artificial recharge of groundwater in small watersheds, methods of artificial recharge, Reclamation of saline soils, Micro farming, biomass management on the farm

PRACTICES:
- Basic Concepts of Wetland Management
- Soil erosion, estimation.
- Methods of soil conservation
- Principles of water harvesting
- Reclamation of saline soils.

SKILLS:
- ➢ Geospatial technique
- ➢ Identify the water resources management outcome from spataial data
- ➢ Identify the different water bodies from spatial images.
- ➢ Develop different Application using images.
- ➢ Develop various water resources Information systems using geospatial data software

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

| Cos	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Describe the elements of geospatial data	Apply	1,2	1, 2, 12
2	Explain basic concepts of geospatial data for water resources	Analyze	1	5, 6, 10
3	Explain the basic components of spatial data	Evaluate	1,2	1, 12
4	Describe the data quality and Explain the different applications of water resources management	Create	2	1, 2, 5, 12

TEXT BOOKS:
1. Hydrogeology by Davis and Dewiest
2. Soil and Water Conservation Engineering by Schwarb, Fengmin, John Wiley, 2002.

REFERENCE BOOKS:

1. Watershed Management for Indian conditions by E.M. Tademan, Omega Scientific Publishers, 2002.

2. Watershed Hydrology by Peter. S. Black, Prentice Hall, 1991.

3. Analysis of flow in water distribution Networks by P.R. Bhave, Technomic Publishing Co., USA, 1991.

4. Geiger, W.F., Marsalek, J. Zudima and Rawls, G. J. (1987 "Manual on Drainage in Urban Areas", 2 Volumes, UNESCO, Paris.1998.

Source Link: https://www.supermap.com/en-us/case/?71_698.html
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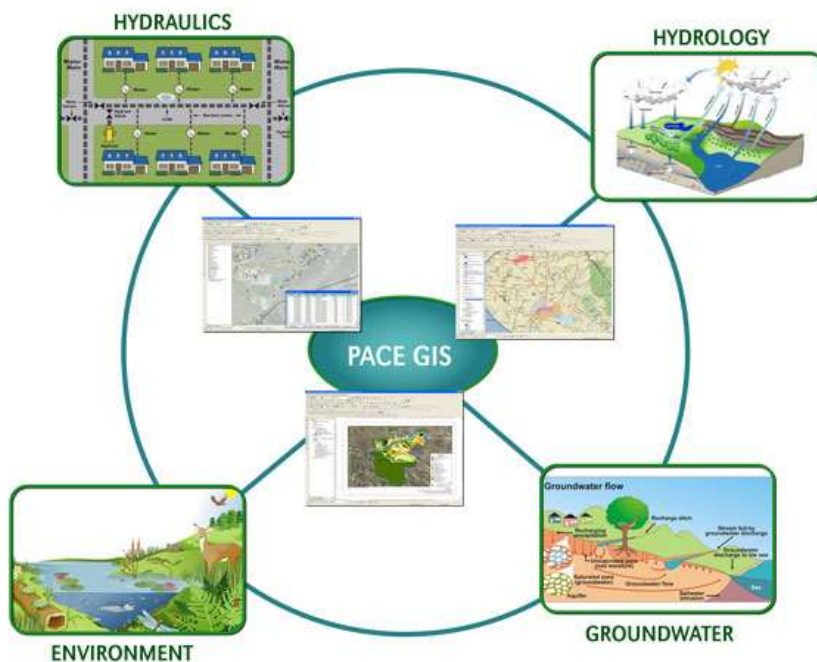
22CE915 - GEOSPATIAL DATA SCIENCE APPLICATIONS

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Geospatial dta science for water resources management.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an introduction to Geospatial data science Applications - a set of hardware, software, and methods for the capture, storage, management, analysis, modelling, and display of geospatial data, used to solve complex geospatial data planning problems. Specific Geospatial data methods are covered for use in a variety of applications.

MODULE 1

UNIT-1   **10L+4T+0P = 14 Hours**

Interpretation: Fundamentals of interpretation, Land use/Land cover mapping, Geological and soil mapping, agriculture, water resources, Rangeland and Wildlife Ecology applications, Interpretation for terrain evaluation – Soil characteristics, Land use suitability.

Plant Sciences: Introduction, Manual interpretation, Structure of the Leaf, Spectral Behavior of the Living Leaf, vegetation Indices, Applications of Vegetation Indices, Phenology, Advanced very High Resolution Radiometer (AVHRR), Separating Soil Reflectance from Vegetation Reflectance, Tasseled Cap Transformation.

UNIT-2   **14L+12T+0P = 26 Hours**

Earth Sciences: Introduction, Photogeology, Lineaments, Geobotany, Direct Multispectral Observation of Rocks and Minerals, Mineral targeting, Photoclinometry, Band Ratios, Soil and Landscape Mapping, Integrated Terrain Units.

Hydrospheric Sciences: Introduction, Spectral Characteristics of Water Bodies, spectral Changes as Water Depth increases, Location and Extent of Water Bodies, Roughness of the water Surface, Bathymetry, Chromaticity diagram, Drainage basin Hydrology, Evapotranspiration, manual interpretation irrigation and command area development, ground water mapping, watershed delineation.

PRACTICES:
- Concept of Image interpretation.
- Land use/Land cover mapping
- Analysis of Land use suitability.
- vegetation Indices.
- Analysis of Vegetation Reflectance

MODULE 2

UNIT-1   **10L+4T+0P = 14 Hours**

Land Use and Land Cover: Introduction, Significance of Land Use and Land Cover Information, Applications of Remote Sensing, Land Use classification, mapping land use change, broad – scale land cover studies.

UNIT-2   **14L+12T+0P = 26 Hours**

Global Remote Sensing: Introduction, Biogeochemical Cycles, Advanced Very High Resolution Radiometer (AVHRR), Earth Observing System, EOS Instruments, EOS Bus, EOS Data and Information system, Long –Term Environment Research Sites, Global Land Information System, Global Data Base.

PRACTICES:
- Land Use and Land Cover Information.
- Land Use classification
- Analysis of Global Remote Sensing.
- Global Land Information System.
- Global Data Base.

SKILLS:
- Geospatial data science technique.
- Identify the outcome from Geospatial data science Applications.
- Identify the different Geospatial data science Applications.
- Develop different Application Geospatial data.
- Develop various Geospatial data Information systems.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

Cos	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Analyze basic concepts of Geospatial data	Analyze	1	5, 6, 10
2	Examine the elements of Geospatial data science Applications	Analyze	1,2	1, 2, 12
3	Evaluate the basic components of Geospatial data science	Evaluate	1,2	1, 12
4	Design Geospatial data quality and different applications of Geospatial data science	Create	2	1, 2, 5, 12

TEXT BOOK:
1. Introduction to Remote Sensing by JAMES B. CAMPBELL. Published by Taylor & Francis
   Ltd.1997.
2. Remote Sensing and Image Interpretation by THOMASLILLESAND AND RALPH W KEIFER published by John Wiley & Sons, 1999.

REFERENCE BOOKS:
1. Analysis of flow in water distribution Networks by P.R. Bhave, Technomic PublishingCo., USA, 1991.
2. Geiger, W.F., Marsalek, J. Zudima and Rawls, G. J. (1987 "Manual on Drainage in Urban

Areas", 2 Volumes, UNESCO, Paris.1998.

Source Link: https://www.supermap.com/en-us/case/?71_698.html
Image:

MINOR ON SMART TECHNOLOGIES IN ENGINEERING
Offered by Department of Civil Engineering

In comparison to traditional structural and functional materials, smart materials and structures are new generation materials and structures that play a significant role in waste reduction. With built-in intelligence, these materials have the ability to adjust to external stimuli like loads or the environment. This type of "smartness" is typically programmed by material composition, specific processing, the addition of defects, or by altering the micro-structure, in order to respond to the various levels of stimuli in a regulated manner. The adjectives "smart" and "intelligent," which are used to describe smart buildings, are also applied to smart materials.

Choosing this minor helps the students to explore smart materials and techniques that are presently being used in our daily life. The following is the list of courses offered in this stream.

Course Code	Course Title	L	T	P	C
22CE906	Infrastructure for Smart Cities	3	2	0	4
22CE907	Intelligent transportation systems	3	2	0	4
22CE908	Low Cost Materials & Techniques	3	2	0	4
22CE909	Smart Materials & Structures	3	2	0	4
22CE910	Urban Infrastructure & Development	3	2	0	4
22CE916	Project Work	0	2	6	4

22CE906 - LOW COST MATERIALS AND TECHNIQUES

	Hours per week:		
L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Building Materials.

COURSE DESCRIPTION & OBJECTIVES:

This course mainly provides about different low cost materials used in construction and techniques. The main objective of this course is to train the students to have a comprehensive knowledge on low cost materials and easy to use different techniques involved in construction of a structure.

MODULE - 1

UNIT-1   **10L+2T+0P = 12 Hours**

CONCEPTS OF LOW COST MATERIALS:

Soil, Fly ash, Ferro-cement, Lime, Fibers, Stone Dust, Red mud, Gypsum, Alternate Wood, and Polymer.

UNIT-2   **14L+14T+0P = 28 Hours**

LOW COST BUILDING MATERIAL PRODUCTS:

Energy Efficient & Environment friendly building material products: Walls - Stabilized and sun dried, soil blocks & bricks, Solid & Hollow concrete blocks, stone masonry blocks, Ferro cement partitions.

Roofs: Pre-cast R.C. Plank & Joists roof, Pre-cast channel roof, Pre-cast L-panel roof, Pre- cast Funicular shells, Ferro cement shells, Filler Slab, Seasal Fibre roof, Improved country tiles, Thatch roof, M.C.R. tile.

PRACTICES:

- Concept of low cost materials
- A case study on low cost materials.
- Study on environment friendly material products.
- Concept of different types of roofs based on use.
- Case study on use of different low cost roofs.

MODULE – 2

UNIT-1   **12L+3T+0P = 15 Hours**

COST EFFECTIVE CONSTRUCTION TECHNIQUES AND EQUIPMENTS:

Techniques: Rat trap bond construction, Energy Efficient roofings, Ferro cement technique, Mud Technology.

Equipments: Brick moulding machine, Stabilized soil block making machine and plants for the manufacturing of concrete blocks, M.C.R. tile making machine, Ferro cement wall panel & Roofing channel making machine, R.C.C. Chaukhat making.

UNIT-2   **12L+13T+0P = 25 Hours**

LOW COST CONSTRUCTION, COST ANALYSIS & COMPARISON:

Cost effective sanitation: Waste water disposal system, Cost effective sanitation for rural and urban areas, Ferro cement Drains.

Low Cost Road Construction: Cost effective road materials, stabilization, construction techniques tests, equipment used for construction, drainage, maintenance.

Cost analysis and comparison: All experimental materials, all experimental techniques.

PRACTICES:
- Use of different equipments in construction.
- Construction techniques.
- Study on cost effective sanitation.
- Low cost road construction.
- An example based on cost analysis and comparision.

SKILLS:
- ➢ Identify all the low cost materials & products.
- ➢ Assess all the properties of materials.
- ➢ Apply suitable techniques and products in construction.
- ➢ Analyze the cost analysis.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

Cos	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify different low cost materials & products used in construction.	Apply	1	1, 2, 12
2	Apply suitable materials & products in construction of a structure.	Apply	1	1, 5, 6
3	Analyze the techniques & equipments in low cost construction.	Analyzing	2	1, 2
4	Determine cost analysis and compare with conventional materials.	Evaluating	2	1, 2, 5, 6

TEXT BOOKS:
1. Alternative Building Materials and Technologies – K S Jagadeesh, B V Venkatta Rama Reddy & K S NanjundaRao – New Age International Publishers.
2. Eugene Eccli- Low Cost, Energy efficient shelter for owner & builder, Rodale Press, 1976.

REFERENCE BOOKS:
1. Hand book of low cost housing - by A. K. Lal – Newage international publishers.
2. Light weight concrete- Academic Kiado- Rudhai. G – Publishing home of Hungarian Academy of Sciences 1963.
3. Modern trends in housing in developing countries – A.G. Madhava Rao- D.S. Ramachandra Murthy & G. Annamalai.

Source Link: https://livinator.com/5-cheap-building-materials-for-a-new-home-on-a-budget/
Image:

22CE907 - SMART MATERIALS AND STRUCTURES

Hours per week:		

L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Low Cost Materials & Techniques.

COURSE DESCRIPTION & OBJECTIVES:

Knowledge of smart materials and structures is essential designing mechanical systems for advanced engineering applications, the course aims at training students in smart materials and structures application and analysis.

MODULE - 1

UNIT-1   **10L+2T+0P = 12 Hours**

SMART MATERIALS:

Smart materials (Physical Properties) Piezoelectric Materials, Elecrostrictive Materials, Magnetostrictive Materials, Magneto electric Materials. Magnetorheological Fluids, Electroheological Fluids, Shape Memory Materials, Fiber-Optic Sensors.

UNIT-2   **14L+14T+0P = 28 Hours**

SMART STRUCTURES: Types of Smart Structures, Potential Feasibility of Smart Structures, Key Elements of Smart Structures, Applications of Smart Structures. Piezoelectric materials, Properties, piezoelectric Constitutive Relations, Depoling and Coersive Field, field strain relation. Hysteresis, Creep and Strain Rate effects, Inchworm Linear Motor.

PRACTICES:

- A study on smart materials.
- Practical application of some smart materials.
- Concept of smart structures.
- Study on piezoelectric materials.
- Case study on smart structures.

MODULE - 2

UNIT-1   **10L+2T+0P = 12 Hours**

SHAPE MEMORY ALLOYS: Experimental Phenomenology, Shape Memory Effect, Phase Transformation, Tanaka''s Constitutive Model, Testing of SMA Wires, Vibration Control through SMA, Multiplexing. Applications of SMA and Problems.

UNIT-2   **14L+14T+0P = 28 Hours**

MICRO – ELECTRICAL MECHANICAL SYSTEMS & DEVICES:

MEMS: Mechanical Properties of MEMS Materials, Scaling of Mechanical Systems, Fundamentals of Theory, The Intrinsic Characteristics of MEMS, Miniaturization, Microelectronics Integration.

Devices: Sensors and Actuators, Conductivity of Semiconductors, Crystal Planes and Orientation, Polymers in MEMS, Optical MEMS Applications.

PRACTICES:

- Concept of Tanaka''s consecutive model.
- Testing of SMA wires.
- Study on mechanical properties of MEMS materials.
- Concept of all devices.

- Working of sensors & actuators with a simple example.

SKILLS:
- Infer the physical properties of smart materials.
- Use different shape memory alloys.
- Construct smart structures.
- Utilize various devices used in smart structures.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

| Cos	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Behaviour and applicability of various smart materials.	Apply	1	1, 2, 5
2	Perform simulations of smart structures & materials application.	Apply	1	1, 2, 5
3	Conduct experiments to verify the predictions.	Evaluate	2	1, 2, 4
4	Design simple models for smart structures & materials.	Create	2	1, 2, 5

TEXT BOOKS:
1. Srinivasan, A. V. and Michael McFarland, D., "Smart Structures: Analysis and Design", Cambridge University Press, 2009.
2. Michelle Addington and Daniel L. Schodek, "Smart Materials and Technologies: For the Architecture and Design Professions", Routledge 2004.
3. Smart Structures: Analysis and Design - A. V. Srinivasan, Cambridge University Press, Cambridge; New York, 2001 (ISBN: 0521650267).

REFERENCE BOOKS:
1. Smart Structures and Materials - B. Culshaw, Artech House, Boston, 1996 (ISBN :0890066817).
2. Smart Materials and Structures/ M. V. Gandhi and B.So Thompson / Chapman & Hall, London; New York, 1992 (ISBN 0412370107).

Source Link: https://www.researchgate.net/figure/Categories-of-smart materials_fig1_337485486

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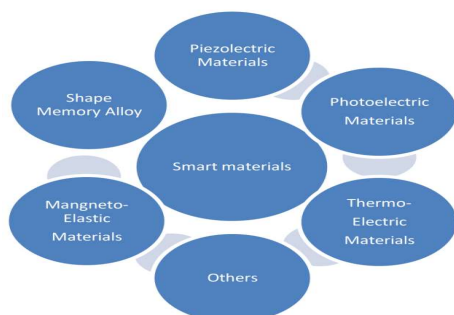
22CE908 - URBAN INFRASTRUCTURE AND DEVELOPMENT

Hours per week:			
L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Smart Materials and Structures.

COURSE DESCRIPTION & OBJECTIVES:

The main objective of this course is to understand and explain Green building concepts, Smart urban transport systems, Water supply and drainage, E-Governance and IOT.

MODULE -1

UNIT-1   **9L+6T+0P = 15 Hours**

GREEN BUILDING CONCEPTS & SUSTAINABLE DEVELOPMENT:

Understanding – Dimensions – Global experience, Global standards and performance bench marks, Practice codes. India 100 smart cities policy and mission, Smart city planning and development, Financing smart cities development, Governance of smart cities.

Green projects in smart cities, sustainability – green building – Rating system – Energy efficient building – energy saving systems.

UNIT-2   **15L+10T+0P = 25 Hours**

SMART URBAN TRANSPORT SYSTEMS:

Elements of Infrastructure (Physical, Social, Utilities and services), Basic definitions, concepts, significance and importance; Data required for provision and planning of urban networks and services; Resource analysis, Provision of infrastructure. Role of transport, types of transport systems, evolution of transport modes, transport problems and mobility issues. Urban form and Transport patterns, land use – transport cycle, concept of accessibility. Hierarchy, capacity and geometric design elements of roads and intersections. Basic principles of Transport infrastructure design. Urban transport planning process –Transport, environment and safety issues. Principles and approaches of Traffic Management, Transport System Management.

PRACTICES:

- Case study on green projects.
- Case study on energy efficient building.
- Study on transport systems, modes and problems.
- Urban transport planning process.
- Environment and safety issues in transport system.

MODULE – 2

UNIT-1   **9L+6T+0P = 15 Hours**

WATER SUPPLY & DRAINAGE:

Water: Sources of water, treatment and storage, transportation and distribution, quality, networks, distribution losses, water harvesting, recycling and reuse, norms and standards of provision, institutional arrangements, planning provisions and management issues.

Sanitation: Points of generation, collection, treatment, disposal, norms and standards, grey water disposal. Municipal and other wastes –generation, typology, quantity, collection, storage, transportation, treatment, disposal, recycling and reuse, wealth from waste, norms and standards, institutional arrangements, planning provisions and management issues.

E- GOVERNANCE & IOT:

The concept of management, concept of e-management & e-business, e-Government Principles, Form e-Government to e-governance, e-governance and developing countries, Designing and Implementing e-Government Strategy, E governance: Issues in implementation. IOT fundamentals, protocols, design and development, data analytics and supporting services, case studies.

PRACTICES:

- Case study on water supplying system in near localities.
- Different treatment process of water.
- Study on recycling and reuse.
- Concept of E-governance.
- Design and development of IOT.

SKILLS:

➢ Development of problem solving skills in management.
➢ Detailed exposure of water and sanitation sector.
➢ Assessment of service delivery gaps, operation and maintenance issues and institutional framework.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

Cos	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Utilize the importance of different linkages and their roles including government, urban planners, universities, city developers and communities.	Apply	2	1, 2, 6
2	Identify and recognize the role of ICT and data analytics in addressing the urban challenges and key issues.	Apply	2	1, 2 6
3	Categorize the fundamental concepts of smart and sustainable cities.	Analyze	1	1, 2
4	Examine the component of smart cities and dwell into their technological advancement.	Analyze	1	1, 2

TEXT BOOKS:

1. Andy Pike, Andres Rodriguez-Pose, John Tomaney, „Handbook of Local and Regional Development", Taylor & Francis, 2010.
2. Daniel G. Parolek, AIA, Karen Parolek, Paul C. Crawford, FAICP, Form Based Codes: A Guide for Planners, Urban Designers, Municipalities, and Developers, John Wiley & Sons, 2008.

REFERENCE BOOKS:

1. Andreas Faludi and Sheryl Goldberg, „Fifty years of Dutch National Physical Planning, Alexandrine Press, Oxford, 1991.
2. Allen G. Noble, (Eds), „Regional Development and Planning for the 21st Century: New Priorities and New Philosophies", Aldershot, USA, 1988.

Source Link: https://www.xamnation.com/urban-infrastructure-in-india-schemes-and- challenges/

Image:

22CE909 - INFRASTRUCTURE FOR SMART CITIES

Hours per week:

L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Urban Infrastructure and Development.

COURSE DESCRIPTION & OBJECTIVES:

The main objective of this course is about Smart Cities within the context of management of urban infrastructures. The introduction of Smart urban technologies into legacy infrastructures have resulted in numerous challenges and opportunities for contemporary cities and will continue to do so. This course will help you to understand how to make the best of these smart technologies in your cities" legacy infrastructures.

MODULE - 1

UNIT-1   **10L+2T+0P = 12 Hours**

FUNDAMENTAL OF SMART CITY & INFRASTRUCTURE:

Introduction of Smart City, Concept of smart city, Objective for smart cities, History of Smart city world and India. Need to develop smart city, Challenges of managing infrastructure in India and world, various types of Infrastructure systems, Infrastructures need assessment.

UNIT-2   **14L+14T+0P = 28 Hours**

PLANNING AND DEVELOPMENT OF SMART CITY INFRASTRUCTURE:

Energy and ecology, solar energy for smart city, Housing, sustainable green building, safety, security, disaster management, economy, cyber security, Project management.

PRACTICES:

- Concept of smart cities.
- Challenges in Infrastructure.
- Solar energy system for smart cities.
- Sustainable green building technology.
- Case study on disaster management.

MODULE – 2

UNIT-1   **10L+2T+0P = 12 Hours**

INFRASTRUCTURE MANAGEMENT SYSTEM & POLICY FOR SMART CITY:

Integrated infrastructure management systems for smart city, Infrastructure management.

UNIT-2   **14L+14T+0P = 28 Hours**

INTELLIGENT TRANSPORT AND WATER RESOURC INFRASTRUCTURE SYSTEMS:

Smart vehicles and fuels, GIS, GPS, Navigation system, traffic safety management, mobility services, E-ticketing. Storage and conveyance system of water, sustainable water and sanitation, sewerage system, flood management, conservation system.

PRACTICES:
- Study on infrastructure management systems for cities.
- Smart vehicles and fuels.
- Study on traffic safety management.
- Concept of storage and conveyance system.
- Case study on flood management.

SKILLS:
- ➢ Develop a basic understanding about various types of Infrastructure and Smart city.
- ➢ National and Global policies to implement for smart city development.
- ➢ Smart transport system for smart cities and its application.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

| Cos	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify components of infrastructure and Prepare infrastructure plan for smart City.	Apply	1	1, 6
2	Study of water resources systems for smart city and its application.	Apply	2	1, 6
3	Apply the basic need and planning concept to solve various Infrastructure problems.	Apply	2	1, 6
4	Analyze the necessity of infrastructural development for smart cities.	Analyze	1	1

TEXT BOOKS:
1. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science.
2. Hudson W.R., Haas R., Uddin W., Infrastructure Management, McGraw-Hill, 1997.

REFERENCE BOOKS:
1. Smart City on Future Life - Scientific Planning and Construction by Xianyi Li.
2. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony Townsend.
3. Grig N.S., Infrastructure engineering and management, Wiley-Interseience, 1988.

Source Link: https://adtellintegration.com/smart-cities-infrastructure/
Image:
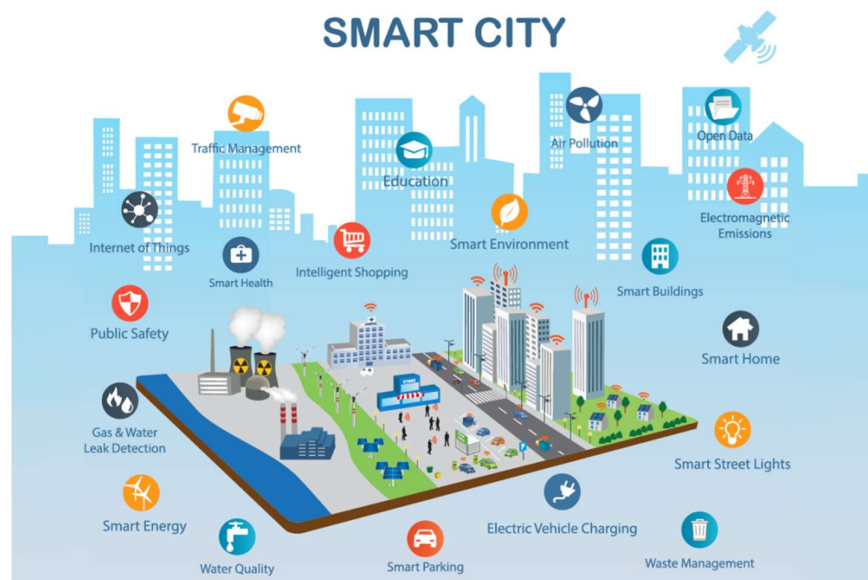
22CE910 – INTELLIGENT TRANSPORTATION SYSTEM

	Hours per week:		
L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Transportation Engineering

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with observing and monitoring the earth surface features in narrow bands and microwave bands of electromagnetic spectrum. Interpreting, analysing these data for better management of Earth resources.

MODULE - 1

UNIT-1   **12L+0T+0P = 12 Hours**

PAVEMENTS:

Pavement Types, Design Factors: Definition, Comparison of pavements. Types of pavements based on structural behaviour – Flexible and Rigid Pavements, Comparison, components and their functions, Soil subgrade, sub-base, Base course and wearing course

UNIT-2   **12L+16T+0P = 28 Hours**

DESIGN:

Design of Flexible pavements: AASHTO Method of Flexible Pavement. Design of Air field Pavements – Corps of Engineers method

Design of Rigid pavements: Design of Joints, Expansion Joints, Contraction Joints, Design of Dowel and Tie bars, Design of Airfield Rigid pavements– LCN System of Pavement design.

PRACTICES:

- Structural Behaviour of Pavements
- AAHTO Method of Design
- Corps of Engineers method
- Airfield Pavements
- LCN System of design

MODULE -2

UNIT-1   **12L+0T+0P = 12 Hours**

URBAN TRANSPORTATION:

Transport Planning: Introduction, Systems approach, Stages in transport planning, survey and analysis of existing conditions, forecast analysis of future conditions and plan synthesis and Evaluation.

UNIT-2   **12L+16T+0P = 28 Hours**

APPLICATIONS:

Trip generation: Trip purpose, Multiple Linear Regression Analysis, Category analysis.

Trip Distribution: Uniform factor method, Average factor method, Fratar method, Furness method, Gravity model, Trannar‟s model, Opportunity model.

Traffic Assignment: All or Nothing Assignment, Multiple Route Assignment, Capacity Restraint Assignment, Design Curves.

PRACTICES:
- Stages of Planning.
- Trip Generation.
- Trip Method and Models.
- Route Assignment
- Restrain Assignment

SKILLS:
➢ Capable of identifying a structural behaviour of pavements
➢ Proficiency in designing a different types of pavements
➢ Able to plan and forecast traffic system in urban areas
➢ Mastery of modelling and assigning traffic in urban areas

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

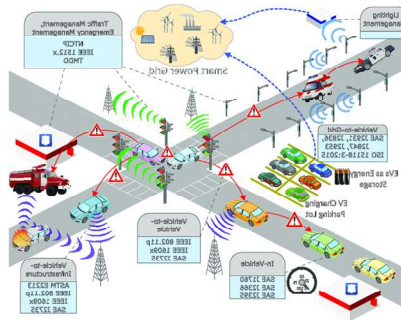| Cos	Course Outcomes	Blooms Level	Module No.	Mapping With POs
1	Interpret the cross section elements and structural behaviour of pavements	Apply	1	1,2,8,12
2	Planning and Forecasting traffic system in urban areas	Analyse	2	1,4,6,7
3	Create the Pavements according to AASHTO and LCN systems	Create	1	1,2,3,4,5,8, 9,10,11,12
4	Create the suitable traffic model for urban areas	Create	2	2,3,5,9,10, 11,12

TEXT BOOKS:
1. Khanna S. K, Justo C E G, "Highway Engineering", 10th edition, NEM Chand and Sons Publications 2018.
2. Kadiyali L R, Traffic Engineering and Transport Planning, Khanna Publishers 2019

REFERENCE BOOKS:
1. Kadiyali L R and Lal, "Highway Engineering Design", Khanna Publications, 2019
2. Partha Chakroborty and Aminesh Das "Principles of Transportation Engineering", Prentice Hall of India, New Delhi. 2017
3. Nicholas J Garber, Traffic and Highway Engineering, Cengage Learning 5th Edition 2019.

Source Link: https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTGGjfWMZOUwIA2BgiV0lXu4EqB3dJSEXkNng&usqp=CAU

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MINOR ON ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Offered by Department of Computer Science and Engineering

The era of Artificial Intelligence & Machine Learning is emerging after two happening decades of Google, social media and smart mobile usage has penetrated massively into our day to day life; AI is going to be the ***next Big Thing*** in technological revolution. As per 2019 Gartner report, already there is a 270% of growth was observed from the year 2015 to 2019.

This AI & ML Minor programis aimed to offer the required skills to the students on variety of applications that can be built using AI / ML methods, tools and techniques. Proficiency in Mathematics and Statistics will be more beneficial to the students to understand theoretical and practical design and implementation of algorithms used in the exploring fields such as Neural Networks, Natural Language Processing, Robotics, Computer Vision, Bigdata Analytics etc. Ample AI career opportunities are present owing to wide applications in different fields include Data Analyst, Data Engineer, Machine Learning Engineer and Business Intelligence Engineer in addition to all computing Job Profiles.

Course Code	Course Title	L	T	P	C
22AM901	Artificial Intelligence	2	2	2	4
22AM902	Computer Vision	3	0	2	4
22AM903	Data Wrangling & Visualization	2	2	2	4
22AM904	Deep Learning	3	0	2	4
22AM905	Digital Image Processing	2	2	2	4
22AM906	Machine Learning	3	0	2	4
22AM907	Introduction to Python Programming	2	2	2	4
22AM908	Text Mining	3	0	2	4
22AM909	Industry 5.0	3	2	0	4
22CS909	Capstone Project	0	2	6	4

22AM901 - ARTIFICIAL INTELLIGENCE

Hours per week:

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Probability & statistics.

COURSE DESCRIPTION AND OBJECTIVES:

The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence. In addition to this, student will understand the building blocks of AI such as search, knowledge representation, inference, logic and learning. This course enables the students to develop a small AI system for real time problems.

MODULE-1

UNIT-1   **6L+6T+6P=18 Hours**

INTELLIGENT SYSTEMS:

Introduction, what is AI, Examples of AI systems, Brief history of AI Agent, Agents and environments, Structure of agents, the concept of rationality, the nature of environments, Types of agents, problem solving approaches to typical AI problem.

UNIT-2   **10L + 10T +10P = 30 Hours**

PROBLEM SOLVING:

State Space Problem; Searching: Uniform search, Informed Search: Solving problems by searching: Heuristic functions, Hill climbing, Best First Search, A* algorithm, AO* algorithm, Searching game trees: Min Max Search, Alpha Beta pruning.

PRACTICES:

- In the classical vacuum cleaner problem, we have two rooms and one vacuum cleaner. There is dirt in both the rooms and it is to be cleaned. The vacuum cleaner is present in any one of these rooms. Find the solution, how we can reach to reach a state in which both the rooms are clean and are dust free.
- In this problem, three missionaries and three cannibals must cross a river using a boat which can carry at most two people, under the constraint that, for both banks, that the missionaries present on the bank cannot be outnumbered by cannibals. The boat cannot cross the river by itself with no people on board. Find the solution, how to solve the given problem.
- You are given two jugs, a 4-gallon one and a 3-gallon one, a pump which has unlimited water which you can use to fill the jug, and the ground on which water may be poured. Neither jug has any measuring markings on it. Find the solution, how can you get exactly 2 gallons of water in the 4-gallon jug?
- There is a farmer who wishes to cross a river but he is not alone. He also has a goat, a wolf, and a cabbage along with him. There is only one boat available which can support the farmer and either of the goat, wolf or the cabbage. So at a time, the boat can have only two objects (farmer and one other). But the problem is, if the goat and wolf are left alone (either in the boat or onshore), the wolf will eat the goat. Similarly, if the Goat and cabbage are left alone, then goat will eat the cabbage. The farmer wants to cross the river with all three of his belongings: goat, wolf, and cabbage. What strategy he should use to do so?

- Either place a block that doesn't have other blocks stacked on top of it on another block with the same behavior, or on the table. The initial and the goal state are described by the exact position of each block. Find the solution, how to solve the given problem.
- Given a 3×3 board with 8 tiles (every tile has one number from 1 to 8) and one empty space. The objective is to place the numbers on tiles to match the final configuration using the empty space. We can slide four adjacent (left, right, above, and below) tiles into the empty space. Find the solution, how to solve the given problem by using A* search algorithm.
- The rules of tic-tac-toe on the 3 × 3 field are as follows. Before the first turn all the field cells are empty. The two players take turns placing their signs into empty cells (the first player places Xs, the second player places Os). The player who places Xs goes first, another one goes second. Find the solution, how to solve the given problem where the winner is the player who first gets three of his signs in a row next to each other (horizontal, vertical or diagonal).
- In crypt arithmetic problem, the digits (0-9) get substituted by some possible alphabets or symbols. The task in crypt arithmetic problem is to substitute each digit with an alphabet to get the result arithmetically correct. Find the solution, how to solve the given problem, where we can perform all the arithmetic operations on a given crypt arithmetic problem.

MODULE-2

UNIT-1   **10L+10T+10P=30 Hours**
KNOWLEDGE REPRESENTATION & PLANNING:
Propositional logic: Inference in propositional logic, Resolution, Forward chaining, Backward chaining, First order logic: Reasoning patterns in First order logic, Resolution, Forward chaining, Backward chaining, The planning problem: Planning with state space search, Partial order planning, Planning graphs.

UNIT-2   **6L+6T+6P = 18 Hours**
LEARNING:
Forms of learning: Supervised Learning, Unsupervised learning, Reinforcement learning, Learning Decision Trees, Ensemble Learning, Expert system.

PRACTICES:
- With logic programming, compare expressions and find out unknown values.
- The Wumpus world is a cave with 16 rooms (4×4). Each room is connected to others through walkways (no rooms are connected diagonally). The knowledge-based agent starts from Room [1, 1]. The cave has – some pits, a treasure and a beast named Wumpus. The Wumpus cannot move but eats the one who enters its room. If the agent enters the pit, it gets stuck there. The goal of the agent is to take the treasure and come out of the cave. The agent is rewarded, when the goal conditions are met. The agent is penalized, when it falls into a pit or being eaten by the Wumpus. Some elements support the agent to explore the cave, like -The Wumpus's adjacent rooms are stench. -The agent is given one arrow which it can use to kill the Wumpus when facing it (Wumpus screams when it is killed). – The adjacent rooms of the room with pits are filled with breeze. -The treasure room is always glittery. Find the Wumpus presented room.
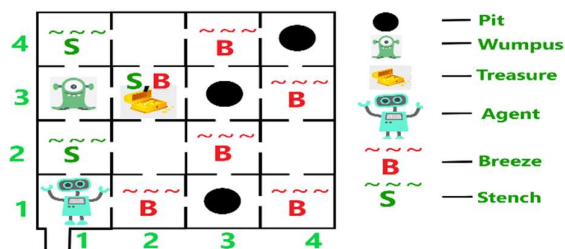
- You are on one side of a river with a wolf, a goat, and a cabbage. You want to transport all three to the other side of the river, but you can only transport one object at a time. You cannot leave the wolf and the goat alone, or the cabbage and the goat alone; you are the only thing keeping them from eating each other. How can you transport everything from one side of the river to the other? Formulate it in terms of a Planning Domain Definition Language (PDDL).
- Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
- Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
- Implement k-nearest neighbors classification using python
- Implement linear regression using python.
- Implement the naïve Bayesian classifier for a sample training dataset. Compute the accuracy of the classifier, considering few test data sets.

SKILLS:

> Analyze Intelligent systems.

> Apply problem solving techniques.

> Interface various knowledge representation.

> Create a dynamic planning.

COURSE OUTCOMES:
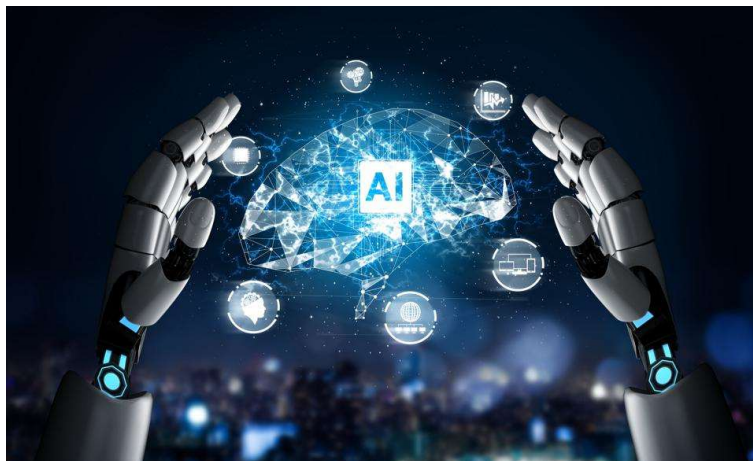Upon completion of the course, the student will be able to achieve the following outcomes:

Co No.	Course Outcomes	Blooms Level	Module	POs
1.	Apply AI search Models and Generic Search strategies for problem solving.	Apply	1	1,3
2.	Design different learning algorithms for improving the performance of AI systems.	Apply	2	4
3.	Apply and evaluate the searching strategies to achieve the goal for a given situation.	Apply	1	6
4.	Inspect and analyze Logic for representing Knowledge and Reasoning of AI systems and Conduct investigation and implement project using AI learning techniques.	Analyze	2	2

TEXT BOOKS:

1. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, PearsonEducation, 2010.

REFERENCE BOOKS:

1. David Poole, Alan Mackworth, Randy Goebel, "Computational Intelligence: a logical approach", Oxford University Press. 2018.
2. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problemsolving", FourthEdition, Pearson Education, 2010.
3. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers, 2013.

https://www.forbes.com/sites/bernardmarr/2020/08/03/3-important-ways-artificial-intelligence-will-transform-your-business-and-turbocharge-success/

22AM902 - COMPUTER VISION

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basic Image Processing, Linear Algebra, Vector Calculus, Python Programming with Open CV and Neuroscience.

COURSE DESCRIPTION AND OBJECTIVES:

This course will cover the fundamentals of Computer Vision. This course provides an understanding of the basic mathematical elements of the image processing and computer vision. It explains and illustrates how the objects are located and identified by the computer in real time environment.

MODULE - 1

UNIT-1   **12L+0T+8P = 20 Hours**

INTRODUCTION TO COMPUTER VISION:

Basic Concepts Of Image Formation: Introduction and Goals of Computer Vision and Image Processing, Bio-Vision Vs Computer-Vision, Brief history of Image Formation Concepts.

Fundamental Concepts Of Image Formation And It's Transformation: Radiometry, Geometric Transformations, Geometric Camera Models, Camera Calibration, 2D and 3D transformations, 2D and 3D rotations and projections, Image Formation in a Stereo Vision Setup, Image Reconstruction from a Series of Projection

UNIT-2   **12L+0T+8P = 20 Hours**

IMAGE AND VISION PROCESSING:

Basic Image Processing: Image generation, Image Enhancement, Image Filtering, Colour Image Processing, Basic Image Segmentation techniques.

Image Descriptors and Features: Texture Descriptors, Colour Features, Edges/Boundaries, Object Boundary and Shape Representations, Interest or Corner Point Detectors, Histogram of Oriented Gradients, Scale Invariant Feature Transform, HoG, LBP, Blobs; Scale Space and Scale Selection; Speeded up Robust Features

PRACTICES:

- Explore and show the practical implementation of the analogy between eye and camera and explain about the vital parts for providing the vision in the human eyes and computers?
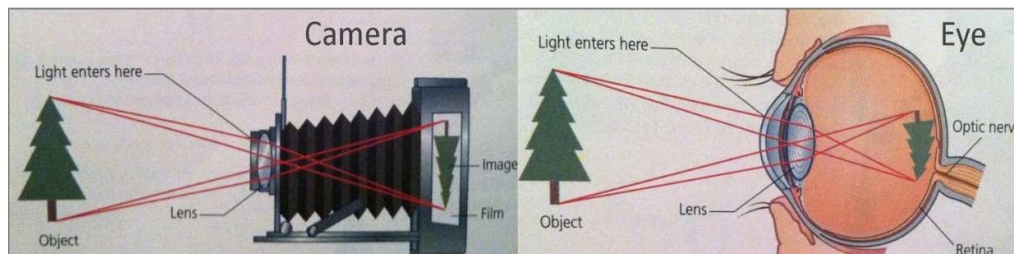
- Explore and discuss what are the basic image formation techniques and describe with an example how image formation technique got evolved into the present form in terms of the time and space complexities (show the implementations of different algorithms).
- Implement an intelligent and optimized technique using image arithmetic and logical operations to enhance the given input image. Discuss how to choose the best method depending on the input image.
- Explore an intelligent row wise and column wise algorithm for pixel operations to enhance (highlight the horizontal and vertical edge operations) the given input image.
- Compute the Harris matrix for 3x3 window highlighted below and compare it with 2x2 and 4x4 windows in terms of complexity?

0	0	1	4	9
1	0	5	7	11
1	4	9	12	16
3	8	11	14	16
8	10	15	16	20

d/dx

-1	0	1

d/dy

-1
0
1

- Discuss and implement a robust technique forperforming gray level slicing on medical imageswith and without background noise.
- Investigate how to revise the technique of histogram equalization to enhance the given input image with salt and pepper noise.
- Write a function to compute the Euclidean distance between the original RGB pixel values and the quantized values. Your function should be called *compute Quantization Error*, should take in inputs *origImg*, *quantizedImg*, and should return an output *error*, where *origImg* and *quantizedImg* are both RGB images, and *error* is a real number.

MODULE - 2
UNIT-1   **12L+0T+8P = 20 Hours**
VISUAL MATCHING:
Feature: Bag-of-words, VLAD, RANSAC, Hough transform, Pyramid Matching, Stereo vision, Correspondence problem, Motion and Optical Flow.

UNIT-2   **12L+0T+8P = 20 Hours**
REAL TIME APPLICATIONS OF COMPUTER VISION:
Artificial Neural Network for Pattern Classification, Gesture Recognition, Motion Estimation, Object detection and Tracking, Face Recognition, Instance recognition, Category recognition, and context and scope understanding.

PRACTICES:
- Discuss and compare different image compression techniques in terms of complexity, and propose an intelligent and fast compression technique appropriate to the input image type.
- Given an input image with noise and degradation write an intelligent algorithm to restore the image.
- Your headlights have a radiant intensity of 60 Wsr−1. Determine the irradiance on a sign 2 meters away.

- Investigate different existing image (Indoor and outdoor images) segmentation algorithms. Design your own segmentation algorithm on Vadlamudi region (extract image form google map) and compare with the state of the are methods.
- Explore different existing image (Indoor and outdoor images) segmentation algorithms. Design your own segmentation algorithm and compare with the state of the are methods.
- Given an RGB image, perform clustering in the 3-dimensional RGB space, and map each pixel in the input image to its nearest center. That is, replace the RGB value at each pixel with its nearest cluster's average RGB value. Show the output image for different value of *K*. Since these average RGB values may not be integers, you should round them to the nearest integer (1 through 255). Your function should be called quantizeRGB, should take in inputs *origImg* and *k*, and return outputs *outputImg, meanColors, clusterIds*. The variables *origImg* and outputImg are RGB images, k specifies the number of colors to quantize to, and *meanColors* is a Kx3 array of the K centers (one value for each cluster and each color channel). *clusterIds* is a *numpixelsx1* matrix *(with numpixels = numrows * numcolumns)* that says which cluster each pixel belongs to.
- A function called *detectEdges* which takes in as input *im*, *threshold* and returns output *edges*. This function computes edges in an image. *im* is the input color image, and *threshold* is a user-set threshold for detecting edges. edges is an *Nx4* matrix containing 4 numbers for each of N detected edge points: the x location of the point, the y location of the point, the gradient magnitude at the point, and the gradient orientation (non-quantized) at the point.
  - In this function, first convert the image to grayscale. Then simply compute the gradient magnitude and orientation at each pixel, and only return those (x, y) locations with magnitude that is higher than the threshold. You can reuse code from HW2.
  - At the end, display, save, and include in your submission the *thresholded* edge image for an image of your choice.
  - Remember that the x direction corresponds to columns and the y direction corresponds to rows.

SKILLS:
- Acquire the basic image formation knowledge and fundamental image processing techniques.
- Analyse the various Segmentation techniques for specific applications.
- Understand more advanced topics and current research literature of Image Processing and Computer Vision.
- Ability to work in industry or in academic research in the field of Computer Vision and Image Processing.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Explorethe fundamental understanding of computer vision and its techniques with its advanced libraries.	Apply	1	1, 2, 12
2	Implement the techniques to have hands on experience with all the techniques.	Apply	1	1, 2, 5, 12

3	Able to design new changes in methods, and make use of different existing techniques to enhance the vision better.	Apply	1	1, 2, 3, 5, 12
4	Capable to analyse and comparereal time models for computer vision problems.	Analyze	2	1, 2, 3, 12
5	Going in depth to find out research outcomes.	Analyze	2	1, 3, 5, 2

TEXT BOOKS:
1. M.K. Bhuyan, "Computer Vision and Image Processing: Fundamentals and Applications", CRC Press, 2020.
2. Forsyth & Ponce, "Computer Vision-A Modern Approach", 2nd edition, Pearson Education, 2012.

REFERENCE BOOKS:
1. R. Hartley and A. Zisserman, "Multiple View Geometry in Computer Vision", 2nd edition, Cambridge University Press, 2004.
2. Simon Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012
3. Richard Szeliski, "Computer Vision- Algorithms & Applications", Springer, 2010.

https://www.kdnuggets.com/2020/06/6-easy-steps-implement-computer-vision-application-tensorflow-js.html

22AM903- DATA HANDLING AND VISUALIZATION

	Hours per week:		
L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Python programming

COURSE DESCRIPTION AND OBJECTIVES:

This course covers the basics of how large data sets are managed to extract meaningful information. This course imparts knowledge required to understand subtle patterns, trends and correlations necessary to understand the data. In addition, this course covers skills required to leverage data and to reveal valuable insights using real example data sets drawn from a variety of different disciplines. Effective data visualization is an important tool as it allows us to quickly examine large amounts of data, expose trends efficiently, exchange ideas with key players, and influence decisions. This course allows the students to work with various tools for visualization of data from a variety of fields.

MODULE-1

UNIT-1   **10L+10T+10P= 30 Hours**
DATA STRUCTURES
NumPy: Creating Arrays, Arrays Operations, Multidimensional Arrays, Arrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix operations.
Pandas Data structures- Series and data fames, working with 1D and 2D data- Creation, accessing, manipulation, various operations

UNIT-2   **6L+6T+6P=18 Hours**
SUB SETTING, FILTERING, AND GROUPING
Sub setting the Data Frame, The unique Function, Conditional Selection and Boolean Filtering, Setting and Resetting the Index, The Group By Method, Aggregating Detecting Outliers and Handling Missing Values: Outlier detection, Missing Values in Pandas, Filling and dropping missing Values in Pandas, Outlier Detection and removing duplicates

PRACTICES:

- **Write code to perform the following operations on Numpy arrays:**
    i. Create a 2D Numpy array with 24 elements of size 4x6 and retrieve the last three rows, retrieve the first two column values, retrieve the sum of the second row, retrieve the sum of first column, and display the max value index in the array
    ii. Create a 2D Numpy array with 42 elements of size 7x6, add a new row, Delete an existing column, replace a specific value, and identify how many values are less than given x
    iii. Create a 1D-array with 64 elements, Reshape the array into 4, 2x8 arrays, also reshape the array into other possible shapes, Convert the data type into float, Split the array into three sub-arrays of same size

    iv.   Create a 2D Numpy array with 35 elements of size 7x5, identify unique values in the array, identify the existence of duplicates, perform conditional replace operations, insert NaNs, replace NaNs,
- Create the following 2D array using Numpy and perform below operations:

2	3	4	5	6
10	11	12	13	14
18	19	20	21	22
26	27	28	29	30
31	33	34	35	36
37	38	39	40	41

    i.   Write the code routine to print the masked (gray) colored sub-array
    ii.   Print the maximum of the fifth row.
    iii. Reshape the array (change columns to rows, rows to columns)
    iv.   Extract all the odd number using conditional logic
    v.   Find the column wise mean, std and variance

- **Apply the following operations on the given csv file**
    i.   Load data from CSV files
    ii.   Retrieve first 10, last 10 rows, 3rd Column and a subgroup
    iii. Query and index operations on the above data frame
    iv.   Insert, delete and update your data
    v.   Apply aggregate operations
    vi.   Apply various filters on the data
    vii. Group, merge, and aggregate data in the data frames

- Apply the following operations on the given csv file

    i.   Load the csv and convert to data Frame
    ii.   Identify the total number of missing values
    iii. Replace the missing values with a constant, with the Mean of that column, with the mode of that column
    iv.   Remove missing values on the original csv file
    v.   Apply fill options and replace

MODULE-2

UNIT-1   **8L + 8T + 8P = 24 Hours**

DATA VISUALIZATION:

Elements of data visualization, Exploration plots: Scatter plots, Line plots, bar plots, box plots, Error-plots, histograms, Kernel-density-estimation plots, Cumulative frequencies, Error-bars, box-plots, bubble-plot, grouped bar charts, pie charts, Advanced plots: correlation, regression, waffle charts, word clouds, Bi-variate, and multivariate plots

UNIT-2   **8L + 8T + 8P = 24 Hours**

DATA VISUALIZATION WITH TABLEAU:

Intro to Tableau, Getting started with Tableau Desktop, connecting to the tutorial dataset, Creating the first charts, Filtering and sorting data, creating common visualizations (bar charts, line charts etc.); Advanced visualizations- Creating more advanced chart types, using multiple source tables; Data Storytelling-Intro to data storytelling, Creating a data story in Tableau.

PRACTICES:

▪ **Plotting with matplotlib and Seaborn**-Load the given csv file and visualize the data with the help of the following graphical representations:

a. Line plots	b. Bar plots	c. Error Plots	d. Scatter plots
e. KDE Plots	f. Heat Maps	g. Box Plots	h. Pie graph
i. Histogram	j. multiple graphs in single figure		k. saving figures

▪ **TABLEAU for visualization**
  o Analyze the given patients data and, based on their information, predict and infer the risk of their health. Then integrate all this analysis into Tableau for easy consumption of the end-users.
  o Analyze the data of sales of a company and infer the past sales numbers of a company and then forecast their sales for the coming quarters and years.
  o Analyze the dataset of marketing campaigns and visualize the performance of various marketing campaigns.
  o Analyze a dataset of product-related information, analyze the trends and showcase the availability of any product at any given point in time.
  o Analyze a dataset of flight-related information, consider different factors of a flight and infer accurate trends for flight prices and visualize.

SKILLS:

➢ Exploratory Data Analysis
➢ Data Visualization
➢ Matplotlib, Seaborn, and Tableau tools usage

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Tool usage for data handling and visualization	Apply	1,2	1, 5
2	Application of data pre-process techniques	Apply	1, 2	1

3	Analyze the given data using exploratory and visualization techniques	Analyze	1,2	2
4	Transforming and developing data suitable for Machine learning applications	Design	2	3

TEXT BOOKS:
1. Thomas Haslwanter, "An introduction to statistics with python-with applications in the life sciences", spinger publisher, 2015.
2. Joshua N. Milligan, "Learning Tableau 2020: Create effective data visualizations, build interactive visual analytics, and transform your organization", 4th Edition, 2020

REFERENCE BOOKS:
1. Wes McKinney, "Python for data analysis", 1st Edition, O'Reilly Media, 2012.
2. Joel Grus, "Data Science from Scratch", O'Reilly Media Inc., 2015.
3. Edward Tufte, "Tableau style guide"

https://www.analyticsvidhya.com/blog/2021/06/must-known-data-visualization-techniques-for-data-science/

22AM904- DEEP LEARNING

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Machine Learning, Python Programming

COURSE DESCRIPTION AND OBJECTIVES:

This course offers sufficient details required to understand the basic building blocks of various deep learning based models. Especially, focuses on different types of neural network models like feed forward neural networks, convolutional neural networks, recurrent neural networks, and deep auto encoders. During this course the students build, train, and evaluate deep neural network models for various applications in image, text, and speech domains. In addition, throughout this course, students will be able to understand hyper parameter tuning and other best-practices to be followed while training deep neural network models.

MODULE-1

UNIT-1   **12L+0T+8P=20Hours**

EVOLUTION OF DEEP NEURAL NETWORKS:

Deep Learning Intuition: History of Deep Learning, What is Deep Learning? Applications of Deep Learning.

Neural Network Basics: McCulloch–Pitts neuron, Perceptron learning rule, Perceptron convergence theorem, Sigmoidal neuron, Multi-layer feed forward neural network, back propagation algorithm, Gradient descent method, Stochastic gradient descent method. Shallow Neural Networks and Deep Neural Networks

REGULARIZATION and OPTIMIZATION for training Deep Models: Optimization methods - Adagrad, Adadelta, RMSProp, Adam; Regularization Methods-Dropout, Drop connect, Batch normalization; Activation functions - Linear, sigmoid, sigmoid, ReLU and variations of ReLU; Losss Function, Improving the training process – Dataset Augmentation, Noise Robustness, Weight Initialization methods, Early stopping, Parameter sharing and tying, bagging and other ensemble methods;

UNIT-2   **12L + 0T + 8P = 20 Hours**

CONVOLUTIONAL NEURAL NETWORKS:

Foundations of Convolutional Neural Network, Popular Deep CNN Models: LeNet, AlexNet, VGGNet, ResNet, Google Net and other architectures.

Instructions for Practices:
- Practice Assignments can be implemented using the Keras / Tensorflow APIs of Python
- Relevant data sets can be downloaded from standard repositories such as Kaggle/UCI or can be developed by the students.

PRACTICES:
- Implement Logistic Regression with Neural Network Mindset
    - logistic regression classifier for classification
    - Plot the loss over each epoch

- Plot the accuracy over each epoch
- Report final Accuracy
- Implement Shallow Neural Network model:
  - Implement a binary classification neural network with a single and multiple hidden layers
  - Implement a Multi-class classification neural network with a single and multiple hidden layers
  - Vary the number of neurons at suitable layers
- Hyper parameter Tuning of a Neural Network model implemented for hand-written digit classification:
  - Vary the type of activation functions
  - Choose suitable Loss functions
  - Vary the number of neurons at suitable layers
  - Vary Weight Initialization methods
  - Save the Best Model and load the saved model
- Building a Deep Neural Network:
  - Implement a multi-class classification neural network with number of layers of your choice
  - Include Batch Normalization layers
  - Vary Optimization methods
  - Add drop out layers
- Convolutional Neural Network Models
  - Design a Convolutional neural network with the layers of your choice
  - Compare the performance by changing the
    - Kernel size
    - Number of feature maps at each convolutional layer
    - Stride
    - Padding
    - Number of fully connected layers
- Visualization of CNN Models
  - Design a Convolutional Neural Network Model for image classification
  - Plot Model Architecture
  - Visualize feature maps after training of CNN
  - Visualize class activation maps

MODULE-2
UNIT-1   **14L + 0T + 10P = 24Hours**
DEEP UNSUPERVISED LEARNING:
Transfer learning Approaches: Deep Pre-trained architectures- AlexNet, VGG16, VGG19, ResNEt. Use deep Convolutional architectures for feature extraction and fine-tuning tasks.
Deep Unsupervised Learning: Autoencoders- Under complete Autoencoders, regularized auto encoders, Representation power, layer size and depth, stochastic encoders and decoders, Denoising auto-encoders, Sparse auto encoder, Contractive auto-encoders

UNIT-2   **10L+0T+6P=16Hours**
RECURRENT NEURAL NETWORKS:
Architecture of an RNN, unfolding of an RNN, Backpropagation through time, Long short term memory (LSTM), Gated recurrent units, Applications- Text Classification, Sentiment Analysis

PRACTICES:

- **Using Deep pre-trained CNN model for feature extraction:**
  - Extract features from the FC1 of VGG network
  - Train any traditional ML model like SVM for classification
  - Repeat the above by considering FC2 of VGG for feature extraction
- **Fine-tuning Deep pre-trained CNN for Classification:**
  - Fine-tune VGG network for the task under consideration
  - Check the performance by making
    - all the layers trainable
    - freezing the initial layers
    - freezing the entire network except the final layer
- Design MLFFNN with 3-level stacked autoencoder based pre-training forBlack and white image data, Display features extracted by different levels of stacked autoencoder at the end of pre-training
- **Sentiment Analysis**
  - Pre-process the text
  - Convert the text into word embeddings
  - Implement the classification network using LSTMs/ GRUs
  - Pre-process the text
  - Convert the text into word embeddings
  - Implement the classification network using LSTMs/ GRUs

SKILLS:

- Developing Vision and text based applications
- Hyperparameter Tuning of a deep Neural network model.
- Tensor Flow/Keras tool usage for neural network implementation

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Leveraging tools to Build deep networks and apply them for real word tasks	Apply	1,2	1,5
2	Implementation of Deep learning models to solve various real-time problems	Apply	1,2	1, 3
3	Analyzeperformance of a deep network and tune its capacity and hyper parameters	Analyze	1	2
4	Developing core components for deep learning algorithms	cREATE	1,2	3

TEXT BOOKS:

1. Ian Good fellow and Yoshua Bengio and Aaron, **"Deep Learning",** 1st Edition, An MIT Press Book, 2016.
2. Charu C. Aggarwal "Neural Networks and Deep learning" Springer International Publishing, 2018

REFERENCE BOOKS:

1. Francois Chollet, "Deep learning with python", 1st edition, Manning Publications, 2017.
2. S. Haykin, "Neural Networks and Learning Machines", 3rd edition, Prentice Hall of India, 2011.
3. Josh Patterson and Adam Gibson, "Deep Learning: A Practitioner's Approach", 1st Edition, O'Reilly, 2017.
4. Satish Kumar, "Neural Networks, A Classroom Approach", Tata McGraw -Hill, 2007
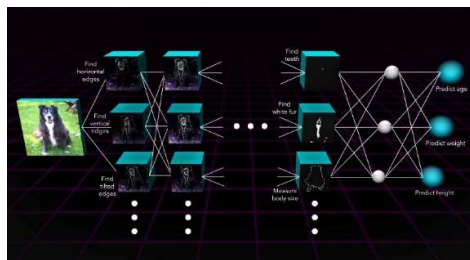
https://www.symmetrymagazine.org/sites/default/files/images/standard/neural_network_visual_final.jpg

22AM905 - DIGITAL IMAGE PROCESSING

		Hours per week:	
L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Probability & Statistics.

COURSE DESCRIPTION AND OBJECTIVES:
This course focuses on imparting knowledge about the aspects of Image Processing and its applications. The main objective of the course is to learn digital image fundamentals, image transforms, image enhancement, restoration and compression, morphological image processing, representation and description.

MODULE-1
UNIT–1   **6L+6T+6P=18 hours**
FUNDAMENTALS OF IMAGE PROCESSING
Fundamental steps in digital image processing, Components of image processing system, A simple image formation model, Image sampling and quantization, Basic relationships between pixels, Introduction to Fourier Transform and DFT – properties of 2D Fourier Transform, FFT.

UNIT–2   **10L+10T+10P=30 hours**
IMAGE ENHANCEMENT IN THE SPATIAL AND FREQUENCY DOMAINS
Basic gray - level transformations, Histogram processing, Basics of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, The basics of filtering in the frequency domain, Image smoothing in frequency domain filters, Image sharpening in frequency domain filters.
Image Segmentation: Fundamentals, Point, Line and edge detection, Thresholding, Region-based segmentation, Segmentation using morphological watersheds, The use of motion in segmentation.

PRACTICES:
- Develop a module to enhance the image by using image arithmetic and logical operations.
- Develop a module for an image enhancement using kernel operations.
- Develop a module for gray level slicing with and without background.
- Develop a module for image enhancement using histogram equalization.
- Develop a module to filter an image using low pass & high pass filter in spatial domain. Compare the performance of both filters.
- Develop a module for smooth an image using low pass & high pass filters in frequency domain. Compare the performance of both filters.
- Develop a module for detecting lines & edges in an image.
- Develop a module for segmenting region of interest.

MODULE-2
UNIT–1   **8L+8T+8P=24 hours**
IMAGE RESTORATION:
A model of image degradation/restoration, Noise models, inverse filtering, wiener filtering, Constrained Least Squares Filtering, Geometric Mean Filter.
Image Compression: Fundamentals, Huffman coding, Golomb coding, LZW coding, Run-length coding.

UNIT–2   **8L+8T+8P=24 hours**
MORPHOLOGICAL IMAGE PROCESSING:
Erosion, Dilation, Opening, Closing, The hit-or-miss transformation; Basic morphological algorithms - boundary extraction, hole filling, extraction of connected components, thinning, thickening, skeletons, pruning.
Feature Extraction: Background, Boundary preprocessing, Boundary Feature Descriptors, Region Feature Descriptors, Principle Components as feature descriptors, Whole-image features.

PRACTICES:
- Develop a module to perform add & removal of salt and pepper noise. Compute PSNR & MSE and check the impact before and after removal of noise.
- Develop a module to remove noise using average filter and median filter. Compute PSNR & MSE before and after removal of noise.
- Develop a module for image compression and decompression.
- Develop a module for morphological image operations -erosion, dilation, opening & closing.
- Develop a module for morphological image operations - hit-or-miss transformation.
- Develop a module for morphological image operations - thinning, thickening
- Develop a module for extracting boundary features of an image.
- Develop a module for extracting features of an image using GLCM.

SKILLS:

- Apply knowledge of science and engineering principles to image related problems.
- Undertake image problem identification and formulate solutions.
- Implement algorithms for enhancement, restoration, compression etc.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	employ image segmentation and representation techniques to extract region of interest	Apply	1	1,2,3,5,12
2	apply various compression techniques to reduce image size and morphological operations to extract features.	Apply	2	1,2,3,5,12
3	learn different feature extraction techniques for image analysis and recognition	Apply	2	1,2,3,5,12
4	Analyse the fundamental concepts of a digital image processing system	Analyse	1	1,2
5	learn different techniques employed for the enhancement of images.	Analyse	1	1,2,3,5,12
6	learn different causes for image degradation and overview of image restoration techniques.	Evaluate	2	1,2,3,5,12

TEXT BOOK:

1. Rafeal C Gonzalez and Richard E.Woods, "Digital Image Processing", 4th edition, Pearson Education/ PHI, 2018.
2. Rafeal C Gonzalez and Richard E.Woods, "Digital Image Processing using MATLAB", 4th edition, PearsonEducation/ PHI, 2020.

REFERENCE BOOKS:

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", 4th Edition, Cengage, 2015.
2. Alasdair McAndrew, "Introduction to Digital Image Processing with Matlab", Thomson CourseTechnology, 2004 Course Technology Press, Boston, MA, United States, 2004.
3. William K. Prat, "Digital Image Processing", 4th Edition, Wiley-Interscience, A John Wiley &Sons, Inc., Publication, 2007.
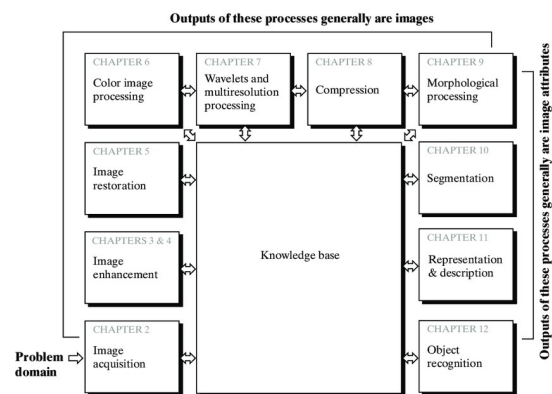
https://www.researchgate.net/figure/Fundamental-steps-in-digital-image-processing_fig10_333856607

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Probability & Linear Algebra, Python language.

COURSE DESCRIPTION AND OBJECTIVES:
This course provides a broad introduction to various machine learning concepts including Supervised learning (parametric/non-parametric algorithms, support vector machines, kernels, neural networks) and Unsupervised learning (clustering, dimensionality reduction) methods. Students will get an understanding of various challenges of Machine Learning and will be able to decide on model complexity. Numerous case studies introduced in this course allow the students to apply machine-learning algorithms in computer vision, medical imaging, audio, and text domains. Laboratory experiments of this course will introduce students to advanced Machine Learning Python libraries such as Scikit-Learn, Matplotlib, and many other recent ML-related APIs. The course is designed such that the students get enough hands-on experience with a major focus on the practical implementation of theoretical concepts.

MODULE-1
UNIT-1   **14L+0T+8P=22 Hours**
INTRODUCTION:
What is machine learning? Machine learning applications; Types of Learning: Supervised learning; Un-supervised learning; Reinforcement learning.

Model Training Essentials: Re-sampling methods: Bias–Variance Trade-off. Hypothesis Testing and Variable Selection, Sub sampling and Upsampling, SMOTE; Cross Validation (validation set, Leave-One-Cut (LOO), k-fold strategies) and bootstrap; Evaluation measures-Error functions, Confusion Matrix, Accuracy, Precision and Recall, F1 Score.

Regression Analysis: Linear Regression, Simple and Multiple Linear Regression, Polynomial Regression, Logistic Regression, Multi nominal Regression. Ordinary Least Squares Method, Model Shrinkage-Ridge, and LASSO regression.

UNIT-2   **10L+0T+8P=18 hours**
FEATURE SELECTION:
Feature Selection Strategies: Problem statement and Uses, Filter methods, Wrapper methods, Embedded methods.   Branch and bound algorithm, Sequential forward/backward selection algorithms.

Dimensionality Reduction: Singular value decomposition, matrix factorization, Linear discriminant analysis, Principal components analysis.

PRACTICES:
▪ Apply the following tasks to any given dataset:
  a. Load and visualize data.

b. Check out and replace missing values.
c. Encode the Categorical data.
d. Splitting the dataset into Training and Test set.
e. Splitting the dataset into k-folds.
f. Feature scaling.

▪ House price prediction:
a. Create a model that predicts a continuous value (price) from input features (square footage, number of bedrooms and bathrooms).
b. Implement a univariate Model using Least Squares and plot best-fit line.
c. Implement a multivariate Model using Least Squares and plot best-fit line.
d. Retrieve model error and model coefficients.
e. Observe Variance Inflation Factor (VIF).
f. Implement Ridge regression model.
g. Implement LASSO regression model.
h. Report your observations on the above models for house prediction.

▪ Heart disease prediction:
a. Implement a logistic regression model to predict whether an individual is suffering from heart disease or not.
b. Evaluate and compare model performance using the following validation approaches:
   i. Validation set approach.
   ii. K-fold cross validation.
   iii. Stratified K-fold cross validation.
   iv. LOO strategy.
c. Plot Confusion matrix.
d. Report performance of the model in terms of the following metrics:
   i. Accuracy.
   ii. Precision-Recall.
   iii. F1 Score.
e. Report your observations and explain when to use what type of measures.

▪ Implement the Polynomial Regression algorithm to fit data points. Select the appropriate data set for your experiment and draw graphs.

▪ Working with imbalanced datasets:
a. Load an imbalanced dataset and visualize imbalance in the data as a bar plot.
b. Implement KNN model for classification.
c. Balance the dataset using:
   i. Random Over sampling.
   ii. Random Under sampling.
   iii. SMOTE.
d. Implement KNN model for classifying data balanced in the above steps.
e. Report your observations on the performance of models trained using balanced and imbalanced data.

▪ Perform effective feature selection in a given dataset using any one of the feature selection techniques.

▪ Dimension Reduction:
a. Load a dataset and Implement Bayes classification model.
b. Apply dimension reduction using:
   i. Principal Component Analysis

ii. Linear Discriminant Analysis

c. Apply the model on data with reduced dimension.

d. Compare and contrast model performance in each case.

MODULE-2

UNIT-1   **16L+0T+8P=24 hours**

CLASSIFICATION:

Classification: Binary, Multi-class and Multi-label Classification; K-Nearest Neighbours, Support Vector Machines, Decision Trees, The Naïve Bayes' Classifier, Class Imbalance, Perceptron ANN model.

Ensemble Methods: Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking.

UNIT-2   **8L+0T+8P=16 hours**

CLUSTERING:

Clustering: Different distance functions and similarity measures, K-means clustering, Medoids, Hierarchical Clustering-Single linkage and Complete linkage clustering, Graph based Clustering -MST, DBSCAN, Spectral clustering.

PRACTICES:

- Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
- Implement the naïve Bayesian classifier for a sample training data set stored as a.csv file. Compute the accuracy of the classifier, considering few test data sets.
- Assuming a set of spam or not-spam mails that need to be classified, use the naïve Bayesian classifier model to perform this task. Calculate the accuracy, precision, and recall for your data set.
- Implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.
- Demonstrate the working of the decision tree-based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample?
- Build a model using SVM with different kernels.
- Implement and build models using the following Ensemble techniques.
  a. Bagging.
  b. Boosting: Adaboost, Stacking.

- Build a model to perform Clustering using K-means after applying PCA and determining the value of K using the Elbow method.
- Unsupervised Modeling:
  a. Cluster the data using the following models:
      i. Spectral Clustering.
      ii. K-medoids.
      iii. DBSCAN.
      iv. Hierarchical Clustering.
  b. Compare and contrast model performance in each case.

SKILLS:

➢ Statistical data analysis.
➢ Classify / Cluster data.
➢ Tool usage for developing ML applications.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply a wide variety of learning algorithms such as Probabilistic, Discriminative and Generative algorithms for a given application.	Apply	1, 2	1
2	Analyze and evaluate the performance of various machine learning models approaches on different kinds of data.	Analyze	2	2
3	Create an end-to-end Machine-learning model to realize solutions for real-world problems.	Create	1	3
4	Implement various machine learning models using advanced ML tools.	Create	1, 2	5

TEXT BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, The MIT Press, 2014.
2. Flach, Peter. "Machine learning: the art and science of algorithms that make sense of data". Cambridge University Press, 2012.

REFERENCE BOOKS:

1. Murphy, Kevin P. Machine learning: a probabilistic perspective. MIT press, 2012.
2. Aurélien Géron, "Hands-on Machine Learning with Scikit Learn and Tensor Flow", O'reilly, 2017.
3. Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, "An Introduction to Statistical Learning with Applications in R", Springer, 2013. (ISLR).

https://www.forbes.com/sites/kalevleetaru/2019/01/15/why-machine-learning-needs-semantics-not-just-statistics/

22AM907-INTRODUCTION TO PYTHON PROGRAMMING

Hours per week:

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Prior knowledge of any programming language and object-oriented concepts is helpful but not mandatory.

COURSE DESCRIPTION AND OBJECTIVES:
This course offers sufficient knowledge required to understand the fundamental concepts of Python programming language. This course enables students to choose appropriate data structures (lists, dictionaries, tuples, sets, strings) for the given problem. In addition, the students will be able to create reliable, modular and reusable applications using Object- Oriented Programming approaches. At the end they will get an idea of how to access database using python programming, develop web applications, and using web services using python programming.

MODULE-1

UNIT-1   **6L+6T+6P=18 Hours**

INTRODUCTION:
Introduction to python, Variables, Assignment, Keywords, Built-in functions, Indentation, Comments, Basic data types - integers, float, complex, Boolean, strings; Python program development, running python using REPL shell, Python scripts.

Operators and Expressions: Operators- arithmetic operators, comparison (relational) operators, assignment operators, logical operators, bitwise operators, membership operators, identity operators; Expressions and order of evaluations.

Control Structures: Conditional control structures - if, elif, else; Loop control structures - for, while, for... else, while…else, nested loops, break, continue, pass.

UNIT-2   **10L+10T+10P=30 Hours**

PYTHON DATA STRUCTURES AND FUNCTIONS:

Data Structures: Lists, Tuples, Sets, Strings, Dictionary - creation, accessing, basic operators and methods; List comprehensions.

Functions: Defining functions, calling functions, Passing arguments - keyword arguments, default arguments, positional arguments, variable-length arguments; Types of functions- anonymous functions, fruitful function, recursive functions; Scope of the variables- global and local variables, Development of recursive and non-recursive functions.

PRACTICES:
- A. Given an integer N, write a program to find its 1's complement.

  B. Given two integers N1 and N2, write a program to find their product without using multiplication ('*') operator and loops.

  C. Given two integers N1 and N2 having same value, write a program to check whether N1 and N2 points to the same object or not.

- A. Given an Integer N, write a program to check whether given number is even or odd without using modulus operator.

B. Given a number N, number of bits K and starting position P, write a program to extract K bits from a position P (from right) in the binary representation of N. Convert the extracted bits in decimal number.

- Given coordinates of centre of a circle, radius and a point coordinate, write a program to check whether the given point lies inside or on the circle, or outside the circle.

- Write a program to find the sum of digits in a given integer.

- Given an integer N as an input, decides the geometrical figure for which the area has to be calculated, for example N=1 for circle, N=2 for rectangle, and N=3 for triangle. Write a program to display the area of the respective figure.

- A semi prime number is an integer which can be expressed as a product of two distinct primes. For example, $15 = 3*5$ is a semi prime number but $9 = 3*3$ is not. For a Given an integer number **N**, write a program to find whether it can be expressed as a sum of two semi-primes or not (not necessarily distinct).

- Given an integer amount X, write a program to find the minimum number of currency notes $ (500, 100, 50, 20, 10, 5, 2, 1) required for the given amount.
  Input:
    575
  Where input is the amount for which we have to calculate the number of currency notes.
  Output: 4
  Explanation: Total amount = 1(500 dollar note) + 1(50 dollar note) + 1(20 dollar note) + 1(5 dollar note) = 575, hence the minimum number of notes required is 4.

- For a given a string S and width W, write a program to wrap the string S into a paragraph of width W.

  Example:

  Input:

  ABCDEFGHIJKLIMNOQRSTUVWXYZ

  4

  Output:

  ABCD   EFGH   IJKL   IMNO   QRST   UVWX
        YZ

- Write a program to Measure the required time to access the first element, nth element and n/2 element stored in list and tuple data structure.

- Given a list L of **N** numbers (integers), Write a program to find the sum of the elements of given list **L** with the corresponding elements of the reverse of list L. If list L has elements **[1,2,3]**, then reverse of the list L will be **[3,2,1]** and the resultant list should

be **[4,4,4]**.

- Given a positive integer number **n**. Write a program to generates a dictionary **d** which contains **(i, i*i*i)** such that **i** is the key and **i*i*i** is its value, where **i** is from **1 to n (both included)**. Print the content of the dictionary **d**.

- Write a program to create a data structure to store student information such as regd no, name, percentage of marks, phone number and display the student details based on the order of percentage of marks.

- For a Given a string, design and implement functions to perform the following:

  a) remove vowels in the given string.

  b) count number of uppercase and lowercase letters.

  c) remove all special characters.

  d) check whether it is a palindrome or not.

  e) swap case of each letter.

- Create a function that receives 3 numbers and returns the median, i.e. the number that is not the min and not the max, but the one in between.

- Given two lists of integer numbers, write a function to perform the following operations.

  a. print elements that are common in both the lists. (Print without duplicates).

  b. print elements that are present in the first list and not present in second list.

  c. print elements that contain the first element of the first list and last element of the second list.

  d. print elements that contain sum of elements of first list and sum of elements of second list.

  e. print largest number of both the lists.

  f. print smallest number of both the lists.

MODULE-2

UNIT-1   **8L+8T+8P=24 Hours**
MODULES:
Creating modules, Import Statement, From...Import Statement, Name Spacing, Creating user defined modules
Standard Modules: sys, math, date, time, os, random and itertools modules.
Packages: Numpy, Pandas, Matplotlib, Requests, Nltk.
File Processing: Reading and writing files -creating a new file, writing to a file, reading text files, opening and closing files, reading, writing, tell (), seek (), rename ().

ERRORS AND EXCEPTIONS:
Introduction to Exceptions, Handling Exception, Try Except Else and Finally Block, Raising Exceptions.
Simple Graphics and Image Processing: Overview of Turtle Graphics, Two Dimensional Shapes, Colours and RBG System and Image Processing

PRACTICES:

- Given a string 'S', find all possible permutations of the string S in lexicographic sorted order. Each Permutation size is "2" or "3".
  Sample Input:
  HACK
  Expected Output: AC AH AK CA CH CK HA HC HK KA KC KH

- Write a program that finds area of the pentagon when length from center of a pentagon to vertex are given, the formula for computing the area of pentagon is $\frac{\sqrt[3]{3}}{2}$ s², where s is the length of the side, the side can be computed using formula s= 2r $\sin\frac{\pi}{5}$, where r is the length from the center of a pentagon to vertex.

- Given X as a date. Write a program to find what the day is on that date.
  Sample Input: 08 05 2015
  Expected Output: Wednesday

- Arun is working in an office which is **N** blocks away from his house. He wants to minimize the time it takes him to go from his house to the office. He can either take the office cab or he can walk to the office. Arun's velocity is **V1 m/s** when he is walking. The cab moves with velocity **V2 m/s** but whenever he calls for the cab, it always starts from the office, covers **N** blocks, collects Arun and goes back to the office. The cab crosses a total distance of **N** meters when going from office to Arun's house and vice versa, whereas Arun covers a distance of (2–√∗N)(2∗N) while walking. Help Arun to find whether he should walk or take a cab to minimize the time.
  Input Format:
  A single line containing three integer numbers N, V1, and V2 separated by a space.
  Example-1:
  Input:
  5 10 15
  Output:
  Cab

- Create a binary NumPy array (containing only 0s and 1s) and convert a binary NumPy array in to to a Boolean NumPy array

- Convert the first column of a Data Frame as a Series by using suitable packages.
  Sample Input:
  Original Data Frame
      col1 col2 col3

```
0    1    4    7
1    2    5    5
2    3    6    8
3    4    9    12
4    7    5    1
5    11   0    11
```
Sample Output:
```
0    1
1    2
2    3
3    4
4    7
5     11
```

- Create two text files and read data from two text files. Display a line from first file followed by the corresponding line from the second file.

- Define the following functions that are more robust to erroneous input data
  a) To divide two numbers (To handle Zero Division Error).
  b) To read two integer numbers and display them (To handle Value Error).
  c) To display elements of a list (To handle Index Error).
  d) To open a file and display file contents (To handle File Not Found Error)

- Write a python program to handle multiple exceptions using raise keyword.
- Draw the spiral hexagon, where we use turtle to create a spiral structure. The final shape is a hexagon and there are various colors used in producing the sides of the hexagon.

- Implement a program to print it in a counterclockwise spiral form for a given square matrix.
  Sample Input:
  ```
      4
      25 1 29 7
      24 20 4 32
      16 38 29 1
      48 25 21 19
  ```
  Sample Output:
  25 24 16 48 25 21 19 1 32 7 29 1 20 38 29 4
- Write a function that finds the nearest prime number of a given number.

SKILLS:
  ➢ Installation and usage of python libraries.
  ➢ Working with varieties of data structures.
  ➢ Improved analytical and problem-solving abilities.
  ➢ Developing structured modular and Object-oriented programming solutions.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Make use of different data types to design programs involving decisions, loops, and functions.	Apply	1	1, 2, 5
2	Develop functional, reliable and User-friendly Python programs for given problem statement and constraints.	Apply	2	1, 2, 3,5
3	Installing the python environment and related packages that are required for practical and contemporary applications.	Apply	2	1, 2,3,5
4	Analyze various features of programming language and their application in problem solving in computer programming to write, compile, and debug programs in python language.	Analyze	1	1, 2
5	Analyze the usage of different data structures for practical and contemporary applications for a given problem.	Analyze	1	1, 2, 3, 5

TEXT BOOKS:

1. Kenneth A. Lambert, "The Fundamentals of Python: First Programs", Cengage Learning, 2011.
2. Mark Lutz, "Learning Python", 5th edition, Orielly Publishers, 2013.

REFERENCE BOOKS:

1. Introduction to Computation and Programming Using Python. John V. Guttag, The MIT Press.
2. James Payne, "Beginning Python using Python 2.6 and Python 3", Wrox publishing.
3. Paul Gries, "Practical Programming: An Introduction to Computer Science using Python 3", The Pragmatic Bookshelf, 2nd edition, 4 Oct. 2013.
4. Allen B. Downey, "Think Python", 1st edition, O'rielly publishing.

https://www.hitalent.co/blog/2019/12/tech-jobs-python-programming-language-and-aws-skills-demand-has-exploded

	L	T	P	C
Hours per week:	3	0	2	4

PREREQUISITE KNOWLEDGE: Data analysis skills, Database, Machine Learning or Deep Learning Algorithms.

COURSE DESCRIPTION AND OBJECTIVES:
This course introduces the fundamental concepts and techniques used in Text Processing. Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information. The course examines models and algorithms used in both the traditional symbolic and the more recent statistical approaches.

MODULE-1

UNIT–1   **10L+0P+6P=16 hours**
INTRODUCTION:
NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The role of machine learning. Brief history of the field.
Regular Expressions, Text Normalization, Edit Distance: Regular Expressions, words, Corpora, Text Normalization and Minimum edit distance.

UNIT–2   **14L+0P+10P=24 hours**
N-GRAMS, VECTOR SEMANTICS AND EMBEDDING:
N-Gram Language Models: N-Grams, Evaluating Language Models, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing, Huge Language Models and Stupid Back off.
Vector Semantics and Embeddings: Lexical semantics, Vector semantics, words and vectors, cosine for measuring similarity, TF-IDF: weighing terms in the vector, Point wise Mutual Information, Applications of TF/ IDP and PPMI vector models, word 2 vec, visualizing embeddings, semantic properties of embeddings, bias and embeddings, evaluating vector models.

PRACTICES:
- Perform basic text pre-processing using the following approaches:
  · Stop word Elimination.
  · Removal of Special Characters.
  - Stemming.
  · Lemmatization.
  - N-gram Tokenization.
- Design and develop a text classification model with various machine learning algorithms over the following feature extraction methods and compare their performance.
  · TF-IDF.
  · Word2Vec.
- Perform Exploratory Data Analysis using following:

· Word Cloud.
· Frequent Word Detection.
· Keyword Extraction based on ranking.

MODULE-2

UNIT–1   **12L+0P+8P=20 hours**
SEQUENCE LABELING FOR PARTS OF SPEECH AND NAMED ENTITIES:
Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech
Tagging, Conditional Random Fields, Evaluation of Named Entity Recognition.

UNIT–2   **12L+0P+8P=20 hours**
SEQUENCE AND TRANSLATION PROCESSING:
Deep Learning Architectures for Sequence Processing: Language Models Revisited, Self-
Attention Networks: Transformers.
Machine Translation and Encoder-Decoder Models: The Encoder-Decoder Model, Encoder-
Decoder with RNNs, Attention, Beam Search, Encoder-Decoder with Transformers.

PRACTICES:
- Perform Named Entity Recognition to extract required entities from a given unstructured
  text using NLTK.
- Perform POS Tagging with HMM and also optimize the performance of HMM with Viterbi.
- Design and develop a text classification model using Latent Dirichlet allocation and compare
  its performance with TF-IDF and Word2Vec.
- Perform text classification using following methods and compare their performance in terms
  of various evaluation metrics such as Accuracy, Precision, Recall and F-Score.

    · CNN   · LSTM   · GRU   - Encoder-Decoder   -Transformers

- Design and develop text classification model using Attention.

SKILLS:

- Exploratory Data analysis.
- Opinion Mining/ Sentiment Analysis using various deep Learning models.
- Text Summarization and Categorization etc.

COURSE OUTCOMES:
Upon completion of the course, the student will be able to achieve the following outcomes:

CO No.	Course Outcome	Blooms Level	PO
1	Make use of Regular Expressions to process the raw text.	Apply	1
2	Apply various approaches to sentiment analysis using Machine Learning methods.	Apply	1
3	Analyze the vector semantics and embedding in the representation of the text.	Analyze	2
4	Create & Develop various statistical approaches to machine translation.	Create	3,4,5

TEXT BOOK:

1. Daniel Jurafsky and James HMartin, "Speech and Language processing: An introduction to Natural Language Processing, Computational Linguistics and speech Recognition", 3rd Edition, 2020.

REFERENCE BOOKS:

1. Steven Bird, Ewan Klein, Edward Lopper, "Natural Language Processing with Python", 1st Edition, O'Reilly Publishers, 2009.
2. Nitin Indurkhya, Fred J. Damerau, "Handbook of Natural Language Processing", 2nd Edition, CRC Publishers, 2010.

https://www.javatpoint.com/text-data-mining
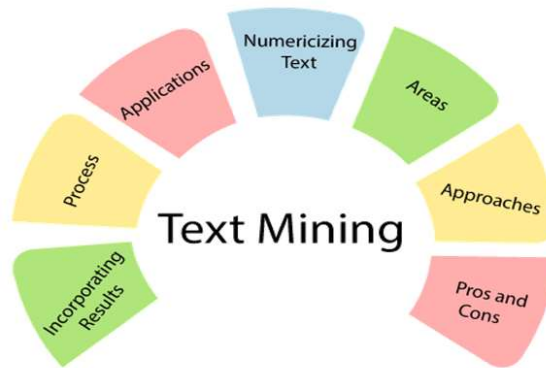
22AM909-INDUSTRY 5.0

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Fundamentals of Automation

COURSE DESCRIPTION AND OBJECTIVES:
This course mainly deals with the concepts of Industrial Internet of Things and its architecture. It provides basic knowledge about IoT, Smart Manufacturing and Social impact of Industry 5.0. It also deals with the technical aspects and architecture of IIoT. The overview of intelligent manufacturing and process planning 4.0, risk management framework are also provided in this course.

MODULE-1

UNIT-1   **9L+6T+0P=18 Hours**

Industry 5.0: Introduction to Industry revolution; Evolution of Industry 1.0 to Industry 5.0; Industry Internet of Things; Power of 1%; Key IoT technologies; Cobots, Human Factors involved; Innovation in IIoT intelligent devices; Challenges and benefits of Industry 5.0; IIoT applications – health care, Oil and Gas Industry, Smart Office, Logistics.

UNIT-2   **15L+10T+0P= 25 Hours**

IIoT Technical Aspects: Miniaturization; Cyber Physical Systems (CPS); Wireless technology; IP technology; Network Functional Virtualization (NFV); Network Virtualization (NV); Software defined network (SDN); NFV vs SDN; smart phones; cloud and fog; big data analytics; M2M learning and AI; Augmented Reality and Virtual Reality; 3D Printing; People vs Automation.

MODULE-2

UNIT-1   **9L+6T+0P=18 Hours**

IIoT Architecture: IIC reference architecture; Industrial Internet Architecture Framework (IIAF); Implementation; architecture topology; Three – tier topology: edge tier, platform tier, enterprise tier, gateway mediated edge, connectivity, key system characteristics, data management.

UNIT-2   **15L+10T+0P= 25 Hours**

Intelligent Manufacturing: Introduction; Cloud manufacturing; IIoT enabled manufacturing; intelligent manufacturing; intelligent manufacturing platforms – GE predix, PTC thingworx, SIEMENS: smart factory; predictive analytics – Google Cloud ML platform, Microsoft Azure.

SKILLS:
➢ Communicate the basic concepts of technologies involved in Smart Manufacturing.
➢ Distinguish the technical aspects and architectures involved in IIoT.
➢ Perform the predictive analytics using Google Cloud ML platform and Microsoft Azure.
➢ Predict the risks and social implications in adaptation of Industry 4.0.
➢ Analyze the risks involved in IIoT and social implications in implementation of IIoT.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Demonstrate the concepts and technologies involved in Internet of Things, Intelligent Manufacturing, Process Planning 4.0	Apply	1	1, 2
2	List out the technical aspects and architecture of Industrial Internet of Things	Apply	1	1, 2
3	Differentiate between the networks and architectures of IIoT.	Analyze	2	1, 2
4	Evaluate the predictive analytics involved in intelligent manufacturing.	Evaluate	2	1, 2

TEXT BOOKS:

1. Uthayan Elangovan, "Industry 5.0:The Future of Industrial Economy", 1st Edition, CRC Press, 2022.
2. Alasdar Gilchrist, "Industry 4.0: The Industrial Internet of Things", 1st Edition, Apress, 2016.

REFERENCE BOOKS:

1. Bruno Salgues, "Society 5.0:Industry of the future,Technologies, Methods and Tools", Volume 1, Wiley, 1st Edition, 2018.
2. Kaushik Kumar, Divya Zindani and J Paulo Davim, "Industry 4.0: Developments towards the Fourth Industrial revolution", Springer, 1st Edition,2019.

Image Source: https://www.momenta.one/hubfs/m21images/industry%205%20-%20landingpage/Industry-5.png

Image Title: INDUSTRY 5.0

MINOR ON COMPUTER SCIENCE
Offered by Department of Computer Science and Engineering

Engineering Graduates with Problem-solving abilities are in high demand in the industry across the globe, as there are many real world problems that need to be addressed. Problem solving and programming skills are very much needed to solve the problems in various industry verticals.

Computer Science and Engineering minor is being offered to students of non-CSE and allied disciplines, to equip them with problem solving and application development skills that enhance job opportunities in IT and related industries. Through this minor programme, students will acquire the skills required to design and develop web, mobile and networking applications.

Course Code	Course Title	L	T	P	C
22CS901	Introduction to Python Programming	2	2	2	4
22CS902	OOPS through JAVA	2	0	4	4
22CS903	Database Management Systems	2	2	2	4
22CS904	Web Technologies	2	0	4	4
22CS905	Mobile Application Development	2	0	4	4
22CS906	Design and Analysis of Algorithms	2	2	2	4
22CS907	Operating Systems and Shell Programming	2	2	2	4
22CS908	Computer Networks	3	0	2	4
22CS909	Capstone Project	0	2	6	4

22CS901 - INTRODUCTION TO PYTHON PROGRAMMING

Hours per week:

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Prior knowledge of any programming language and object-oriented concepts is helpful but not mandatory.

COURSE DESCRIPTION AND OBJECTIVES:
This course offers sufficient knowledge required to understand the fundamental concepts of Python programming language. This course enables students to choose appropriate data structures (lists, dictionaries, tuples, sets, strings) for the given problem. In addition, the students will be able to create reliable, modular and reusable applications using Object- Oriented Programming approaches. At the end they will get an idea of how to access database using python programming, develop web applications, and using web Services using python
Programming.

MODULE-1

UNIT-1   **6L+6T+6P=18 Hours**
INTRODUCTION:
Introduction to python, Variables, Assignment, Keywords, Built-in functions, Indentation, Comments, Basic data types - integers, float, complex, Boolean, strings; Python program development, running python using REPL shell, Python scripts.
Operators and Expressions: Operators- arithmetic operators, comparison (relational) operators, assignment operators, logical operators, bitwise operators, membership operators, identity operators; Expressions and order of evaluations.
Control Structures: Conditional control structures - if, elif, else; Loop control structures - for, while, for... else, while…else, nested loops, break, continue, pass.

UNIT-2   **10L+10T+10P=30 Hours**
PYTHON DATA STRUCTURES AND FUNCTIONS:
Data Structures: Lists, Tuples, Sets, Strings, Dictionary - creation, accessing, basic operators and methods; List comprehensions.
Functions: Defining functions, calling functions, Passing arguments - keyword arguments, default arguments, positional arguments, variable-length arguments; Types of functions- anonymous functions, fruitful function, recursive functions; Scope of the variables- global and local variables, Development of recursive and non-recursive functions.

PRACTICES:
- A. Given an integer N, write a program to find its 1's complement.

  B. Given two integers N1 and N2, write a program to find their product without using multiplication ('*') operator and loops.

  C. Given two integers N1 and N2 having same value, write a program to check whether N1 and N2 points to the same object or not.

- A. Given an Integer N, write a program to check whether given number is even or odd without using modulus operator.

  C. Given a number N, number of bits K and starting position P, write a program to extract K bits from a position P (from right) in the binary representation of N. Convert the extracted bits in decimal number.

- Given coordinates of centre of a circle, radius and a point coordinate, write a program to check whether the given point lies inside or on the circle, or outside the circle.

- Write a program to find the sum of digits in a given integer.

- Given an integer N as an input, decides the geometrical figure for which the area has to be calculated, for example N=1 for circle, N=2 for rectangle, and N=3 for triangle. Write a program to display the area of the respective figure.

- A semi prime number is an integer which can be expressed as a product of two distinct primes. For example, 15 = 3*5 is a semi prime number but 9 = 3*3 is not. For a Given an integer number **N**, write a program to find whether it can be expressed as a sum of two semi-primes or not (not necessarily distinct).

- Given an integer amount X, write a program to find the minimum number of currency notes $ (500, 100, 50, 20, 10, 5, 2, 1) required for the given amount.
  Input:
  575
  Where input is the amount for which we have to calculate the number of currency notes.
  Output: 4
  Explanation: Total amount = 1(500 dollar note) + 1(50 dollar note) + 1(20 dollar note) + 1(5 dollar note) = 575, hence the minimum number of notes required is 4.

- For a given a string S and width W, write a program to wrap the string S into a paragraph of width W.

  Example:

  Input:

  ABCDEFGHIJKLIMNOQRSTUVWXYZ

  4

  Output:

  ABCD   EFGH   IJKL   IMNO   QRST   UVWX

            YZ

- Write a program to Measure the required time to access the first element, nth element and n/2 element stored in list and tuple data structure.

- Given a list L of **N** numbers (integers), Write a program to find the sum of the elements of given list **L** with the corresponding elements of the reverse of list L. If list L has elements **[1,2,3]**, then reverse of the list L will be **[3,2,1]** and the resultant list should be **[4,4,4]**.

- Given a positive integer number **n**. Write a program to generates a dictionary **d** which contains **(i, i*i*i)** such that **i** is the key and **i*i*i** is its value, where **i** is from **1 to n (both included)**. Print the content of the dictionary **d**.

- Write a program to create a data structure to store student information such as regd no, name, percentage of marks, phone number and display the student details based on the order of percentage of marks.

- For a Given a string, design and implement functions to perform the following:

  a) remove vowels in the given string.

  b) count number of uppercase and lowercase letters.

  c) remove all special characters.

  d) check whether it is a palindrome or not.

  e) swap case of each letter.

- Create a function that receives 3 numbers and returns the median, i.e. the number that is not the min and not the max, but the one in between.

- Given two lists of integer numbers, write a function to perform the following operations.

  a. print elements that are common in both the lists. (Print without duplicates).

  b. print elements that are present in the first list and not present in second list.

  c. print elements that contain the first element of the first list and last element of the second list.

  d. print elements that contain sum of elements of first list and sum of elements of second list.

  e. print largest number of both the lists.

  f. print smallest number of both the lists.

MODULE-2

UNIT-1   **8L+8T+8P=24 Hours**

MODULES:

Creating modules, Import Statement, From...Import Statement, Name Spacing, Creating user defined modules

Standard Modules: sys, math, date, time, os, random and itertools modules.

Packages: Numpy, Pandas, Matplotlib, Requests, Nltk.

File Processing: Reading and writing files -creating a new file, writing to a file, reading text files, opening and closing files, reading, writing, tell (), seek (), rename ().

UNIT-2   **8L+8T+8P=24 Hours**
ERRORS AND EXCEPTIONS:
Introduction to Exceptions, Handling Exception, Try Except Else and Finally Block, Raising Exceptions.
Simple Graphics and Image Processing: Overview of Turtle Graphics, Two Dimensional Shapes, Colours and RBG System and Image Processing

PRACTICES:

- Given a string 'S', find all possible permutations of the string S in lexicographic sorted order. Each Permutation size is "2" or "3".
  Sample Input:
  HACK
  Expected Output: AC AH AK CA CH CK HA HC HK KA KC KH

- Write a program that finds area of the pentagon when length from center of a pentagon to vertex are given, the formula for computing the area of pentagon is $\frac{\sqrt[3]{3}}{2}$ s², where s is the length of the side, the side can be computed using formula s= 2r sin $\frac{\pi}{5}$, where r is the length from the center of a pentagon to vertex.

- Given X as a date. Write a program to find what the day is on that date.
  Sample Input: 08 05 2015
  Expected Output: Wednesday

- Arun is working in an office which is **N** blocks away from his house. He wants to minimize the time it takes him to go from his house to the office. He can either take the office cab or he can walk to the office. Arun's velocity is **V1 m/s** when he is walking. The cab moves with velocity **V2 m/s** but whenever he calls for the cab, it always starts from the office, covers **N** blocks, collects Arun and goes back to the office. The cab crosses a total distance of **N** meters when going from office to Arun's house and vice versa, whereas Arun covers a distance of (2–√∗N)(2∗N) while walking. Help Arun to find whether he should walk or take a cab to minimize the time.
  Input Format:
  A single line containing three integer numbers N, V1, and V2 separated by a space.
  Example-1:
  Input:
  5 10 15
  Output:
  Cab

- Create a binary NumPy array (containing only 0s and 1s) and convert a binary NumPy array in to to a Boolean NumPy array

- Convert the first column of a Data Frame as a Series by using suitable packages.

  Sample Input:

  Original Data Frame

	col1	col2	col3
0	1	4	7
1	2	5	5
2	3	6	8
3	4	9	12
4	7	5	1
5	11	0	11

  Sample Output:

0	1
1	2
2	3
3	4
4	7
6	11

- Create two text files and read data from two text files. Display a line from first file followed by the corresponding line from the second file.
- Define the following functions that are more robust to erroneous input data

  a) To divide two numbers (To handle Zero Division Error).

  b) To read two integer numbers and display them (To handle Value Error).

  c) To display elements of a list (To handle Index Error).

  d) To open a file and display file contents (To handle File Not Found Error)
- Write a python program to handle multiple exceptions using raise keyword.
- Draw the spiral hexagon, where we use turtle to create a spiral structure. The final shape is a hexagon and there are various colors used in producing the sides of the hexagon.
- Implement a program to print it in a counterclockwise spiral form for a given square matrix.

  Sample Input:

  ```
      4
      25 1 29 7
      24 20 4 32
      16 38 29 1
      48 25 21 19
  ```

  Sample Output:

  25 24 16 48 25 21 19 1 32 7 29 1 20 38 29 4
- Write a function that finds the nearest prime number of a given number.

SKILLS:

- Installation and usage of python libraries.
- Working with varieties of data structures.
- Improved analytical and problem-solving abilities.

➢ Developing structured modular and Object-oriented programming solutions.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Make use of different data types to design programs involving decisions, loops, and functions.	Apply	1	1, 2, 5
2	Develop functional, reliable and User-friendly Python programs for given problem statement and constraints.	Apply	2	1, 2, 3,5
3	Installing the python environment and related packages that are required for practical and contemporary applications.	Apply	2	1, 2,3,5
4	Analyze the usage of different data structures for practical and contemporary applications for a given problem.	Analyze	1	1, 2, 3, 5
5	Analyze various features of programming language and their application in problem solving in computer programming to write, compile, and debug programs in python language.	Analyze	1	1, 2

TEXT BOOKS:

1. Kenneth A. Lambert, "The Fundamentals of Python: First Programs", Cengage Learning, 2011.
2. Mark Lutz, "Learning Python", 5th edition, Orielly Publishers, 2013.

REFERENCE BOOKS:

1. Introduction to Computation and Programming Using Python. John V. Guttag, The MIT Press.
2. James Payne, "Beginning Python using Python 2.6 and Python 3", Wrox publishing.
3. Paul Gries, "Practical Programming: An Introduction to Computer Science using Python 3", The Pragmatic Bookshelf, 2nd edition, 4 Oct. 2013.
4. Allen B. Downey, "Think Python", 1st edition, Orielly publishing.

https://www.hitalent.co/blog/2019/12/tech-jobs-python-programming-language-and-aws-skills-demand-has-exploded

Hours per week:

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Classes, Objects and Inheritance.

COURSE DESCRIPTION AND OBJECTIVES:

This course is about the fundamentals of Object-Oriented Programming (OOP) Concept and OOP-based software development methodology. Java as a class-based and pure OOP language is used to demonstrate and implement appropriate concepts and techniques. The students are exposed to the concepts, fundamental syntax, and the thought processes behind object- oriented programming. By end of the course, students will acquire the basic knowledge and skills necessary to implement object-oriented programming techniques in software development using Java.

MODULE-1
UNIT-1   **6L+0T+12P=18 Hours**
INTRODUCTION:
History of Java, Byte code, JVM, Java buzzwords, OOP principles, Data types, Variables, Scope of variables, Operators, Control statements, Type conversion and casting, Arrays.
Concepts Of Classes and Objects: Introduction to methods, Method over loading, Constructors, Construct or over loading, Usage of *static* with data and method, Access control, *this* key word, Garbage collection, String class, String Tokenizer.

UNIT-2   **10L+0T+20P=30 Hours**
INHERITANCE AND EXCEPTIONS:
Inheritance: Type so finheritance, Member access rules, Usage of *super* key word, Method *overriding*, Usage of *final*, Abstract classes, Interfaces - differences between abstract classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces. Packages-defining, creating and accessing a package, importing packages, access control in packages.
Exception Handling: Concepts of exception handling, Types of exceptions, Usage of try, catch, throw, throws and finally keywords, Built-in exceptions, User defined exception.

PRACTICES:

- There is a telecommunication company called "Powered Air" who have approached you to build their Interactive Voice Response (IVR) system. write a Java program and be able to provide the following menu (given below):

  Note: User should provide an input for each menu display. Welcome to Powered Air service. What would you like to do?

a.	Know my balance.	b.	Know my validity date
c.	Know number of free calls available.	d.	More

1. Prepaid Bill Request	2. Customer Preferences
3. GPRS activation	4. Special Message Offers

            You are free to display your own messages in this IVR.

- Create a class *Rectangle*. The class has attributes length and width. It should have methods that calculate the perimeter and area of the rectangle. It should have read Attributes method to read length and width from user.
    - Hint: Area of rectangle = length * width, Perimeter of rectangle = 2*(length+width).
- Implement a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers (use StringTokenizer class).
- Implement a java program to print all tokens of a string on the bases of multiple separators (use StringTokenizer class).
- Using inheritance, one class can acquire the properties of others. Consider a class *Animal* that has only one method "walk". Next, create a *Bird* class that also has a fly method. Finally, create a bird object that can both fly and walk.
- Using inheritance ,Write the following code in your editor :
  1. A class named *Arithmetic* with a method named "add" that takes integers as parameters and returns an integer denoting their sum.
  2. A class named *Adder* that inherits from a superclass named *Arithmetic*.
    - Note: Your classes should not be Public.
- When a subclass inherits from a superclass, it also inherits its methods; however, it can also override the superclass methods (as well as declare and implement new ones). Consider the *Sports* class having methods *getName*()[which returns name of sport] and *getNumberOf TeamMembers*()[which returns noof team members] create a *Soccer* class that inherits from the *Sports* class. We can override the get Name method and return a different subclass-specific string and override *getNumberOfTeamMembers method and* return noof team members
- Implement a java program to create an abstract class named Shape that contains an empty method named number Of Sides ( ).Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method number Of Sides ( ) that shows the number of sides in the given geometrical figures.
- You are given an interface *Advanced Arithmetic* which contains a method signature *int divisor_sum(int n)*. You need to write a class called My Calculator which implements the interface.*divisor_sum* function just takes an integer as input and return the sum of all its divisors. For example divisors of 6 are 1, 2, 3 and 6, so *divisor_sum* should return 12. The value of n will be at most 1000.
- Implement a Java program for the following
- Creation of simple package.
- Accessing a package.
- Implement a Java program to read two numbers a,b from user and perform division a/b,if the user passes b value as zero, handle the exception using try and catch otherwise display the result.
- Create a class called *Customer* with data members account_number, balance (initialize with 10000), and member functions *print(), deposit(),* and *withdraw()*. Print method display account number and balance. If withdraw amount is less than current balance while withdrawing, throw an exception "In Sufficient Funds". If the input is 1 do print. If the input is 2 withdraw (). If the input is 3 deposit. If the input is 4 terminate program.
- Implement a Java program which acceptsage as input from the user and throws an exception
    - "Not Eligible to Vote" when age is <=18 otherwise print "Eligible to Vote".

UNIT-1   **8L+0T+16P=24 Hours**
MULTI THREDING AND FRAMEWORK:
Multithreading: Concepts of multi threading, Differences between process and thread, Thread life cycle, Creating multiple threads using Thread class and Runnable interface, Synchronization, Thread priorities, Inter thread communication.
Collection Framework: Collections Overview, Collection Interfaces - List, Set, Map, List – Array List, Linked List, Vector, Set - HashSet, TreeSet, Map - HashTable, HashMap, accessing a collection via an Iterator, comparator, comparable.

UNIT-2   **8L+0T+16P=24 Hours**
SWINGS:
GUI Programming With Swing: Delegation event model-Events, Event sources, Event Listeners, Event classes, handling mouse and keyboard events.
Exploring Swing Controls: JLabel and Image Icon, JText Field, JButton, JCheckBox, JRadioButton, JTabbed Pane, JList, JCombo Box.

PRACTICES:

- **Print in Order**
  Suppose we have a class:
  public class Foo {
  public void first() { print("first"); }
  public void second() { print("second"); }
  public void third() { print("third"); }
  }

  The same instance of Foo will be passed to three different threads. Thread A will call first(), thread B will call second(), and thread C will call third(). Design a mechanism and modify the program to ensure that second() is executed after first(), and third() is executed after second().

  Note:

  We do not know how the threads will be scheduled in the operating system, even though the numbers in the input seem to imply the ordering. The input format you see is mainly to ensure our tests' comprehensiveness.

  Example 1:

  Input: nums = [1,2,3]

  Output: "firstsecondthird"

  Explanation: There are three threads being fired asynchronously. The input [1,2,3] means thread A calls first(), thread B calls second(), and thread C calls third(). "firstsecondthird" is the correct output.

  Example 2:

Input: nums = [1,3,2]

Output: "firstsecondthird"

Explanation: The input [1,3,2] means thread A calls first(), thread B calls third(), and thread C calls second(). "firstsecondthird" is the correct output.

▪ **Flood Fill:**

An image is represented by an m x n integer grid image where image[i][j] represents the pixel value of the image.

You are also given three integers sr, sc, and color. You should perform a flood fill on the image starting from the pixel image[sr][sc].

To perform a flood fill, consider the starting pixel, plus any pixels connected 4-directionally to the starting pixel of the same color as the starting pixel, plus any pixels connected 4-directionally to those pixels (also with the same color), and so on. Replace the color of all of the aforementioned pixels with color.

Return the modified image after performing the flood fill.
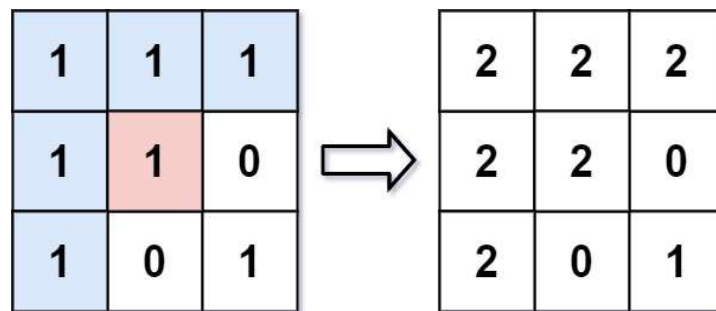
Example 1:

Input: image = [[1,1,1],[1,1,0],[1,0,1]], sr = 1, sc = 1, color = 2

Output: [[2,2,2],[2,2,0],[2,0,1]]

Explanation: From the centre of the image with position (sr, sc) = (1, 1) (i.e., the red pixel), all pixels connected by a path of the same color as the starting pixel (i.e., the blue pixels) are colored with the new color.

Note the bottom corner is not coloured 2, because it is not 4-directionally connected to the starting pixel.
Example 2:
Input: image = [[0,0,0],[0,0,0]], sr = 0, sc = 0, color = 0
Output: [[0,0,0],[0,0,0]]
Explanation: The starting pixel is already colored 0, so no changes are made to the image.

- **Count words in a given string**

  The input parameter is a list of strings representing lines of text.

  Count how often the word occurs in the text.

  If the word "kitten" occurred in a text 23 times, then its entry would be "kitten - 23\n". Return statistics as a String containing all the entries.

  Omit all words which contain less than 4 letters and appear less than 10 (the words which are too small or to rare) The entries in the resulting String should be also sorted by their amount and then in alphabetical order if it is needed.

- Implement a Java program for handling mouse events when the mouse entered, exited, clicked, pressed, released, dragged and moved in the client area.
- Implement a Java program for handling key events when the key board is pressed, released, typed.
- Implement a Java swing program that reads two numbers from two separate text fields and display sum of two numbers in third text field when button "add" is pressed.
- Implement a Java program to design student registration form using Swing Controls. The form which having the following fields and button "save". Form Fields are: Name, RNO, Mail id, Gender, Branch, and Address.
- Implement a java program using swings to design a multiple choice question having three options (use radio button) ,display the message using dialog box "Your answer is wrong" if the user selects wrong option otherwise display ,"Your answer is correct."

SKILLS:

- To analyse and develop algorithm for real life problems using Java**.**
- Experience with developing and debugging programs in different IDEs.
- Develop multi-threaded applications.
- Creating web applications.

COURSE OUTCOMES
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply object oriented concepts on real time scenarios.	Apply	1	1,2
2	Apply the concepts of Multithreading and Exception handling to develop efficient and error free codes	Apply	1, 2	1,2
3	Create and develop Java applications to solve real world problems by using modern tools and collection framework	Create	2	3,5
4	Create and develop GUI based applications using swings forinternet and system based applications.	Create	2	3,5

TEXT BOOKS:

1. Herbert Schildt, "Java the complete reference", 12th Edition, McGraw Hill, Education, 2021.
2. M.T. Somashekara, D.S. Guru, K.S. Manjunatha, "Object-Oriented Programming with Java", 1st Edition, PHI Learning, 2017.

REFERENCE BOOKS:

1. E. Balagurusamy, "Programming with Java", 6th Edition, McGraw Hill, 2019.
2. Mark Lassoff, "Java Programming for Beginners: Learn the fundamentals of programming with Java", 1st Edition, Packt Publishing Limited,2017.
3. Philip Conrod, Lou Tylee, "Learn Java GUI Applications: A JFC Swing Tutorial", 11th Edition, Kidware Software, 2019.

https://www.datasciencecentral.com/wp-content/uploads/2021/10/8667507462.jpeg

	Hours per week:		
L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Discrete Mathematical Structures.

COURSE DESCRIPTION AND OBJECTIVES:

This course presents an introduction to database management systems with an emphasis on how to organize, maintain and retrieve data efficiently from a relational database. It also focuses on requirements gathering and conceptual, logical, physical database design. The objective of the course is to enable the student to understand database design, expressing queries using SQL, query optimization and transaction processing.

MODULE-1

UNIT–1   **10L+6T+4P=20 Hours**

DATABASE SYSTEM CONCEPTS:

Databases And Database Users: Introduction; Characteristics of the database approach; Actors on the scene; Advantages of using DBMS approach.

Database System Concepts and Architecture: Data models, Schemas and instances; Three-Schema architecture and data Independence; Database languages and interfaces; The database system environment; Centralized and Client-Server architectures for DBMS.

Conceptual Data Modeling and Database Design: Entity types, Entity sets, Attributes and keys; Relationship types, Relationship sets, Roles and structural constraints; Weak entity types; Relationship types.

UNIT–2   **6L+10T+12P=28 Hours**

RELATIONAL DATABASE DESIGN:

Relational Database Design by ER–To-Relational Mapping: Relational Database design using ER-to-Relational mapping.

The Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and Relational database schemas.

Relational Algebra: Unary relational operations - SELECT and PROJECT; Relational algebra operations from set theory; Binary relational operations- JOIN and DIVISION.

SQL: SQL data definition and data types; specifying constraints in SQL, Basic retrieval queries in SQL; INSERT, DELETE, and UPDATE statements in SQL.

PRACTICES:

- Design ER Model for various real time database applications.
- Development of Relational Database schemas for Company/Student/Sailors/ using DDL constructs of SQL.
- Apply various DML Commands such as select, insert, update etc. of SQL on Relational Database.
- Design of Relational Database schemas by specifying different types of Constraints.
- Apply various Relational Database operators (Arithmetic, Logical &comparison) and string-matching constructs of SQL.
- Expressing queries using Aggregate Functions of SQL on Relational Database.
- Queries on Relational Database using GROUP BY, HAVING and ORDER BY clauses of SQL.

MODULE-2

UNIT–1   **8L+8T+12P=28 Hours**
NORMALIZATION:
Complex Queries, Triggers, Views: More complex SQL retrieval queries; Specifying constraints as assertions and actions as triggers; Views (virtual tables) in Pl/SQL.
Basics Of Functional Dependencies and Normalization for Relational Databases: Informal design guidelines for relation schemas; Functional dependencies-inference rules, equivalence and minimal cover; Normal forms based on primary keys; Boyce-Codd normal form; Properties of relational decompositions, multi valued dependency, join dependencies.

UNIT-2   **8L+8T+4P=20 Hours**
TRANSACTION PROCESSING:
Introduction To Transaction Processing Concepts and Theory: Introduction to transaction processing; Transaction and system concepts; Desirable properties of transactions; Characterizing schedules based on serializability.
Concurrency Control Techniques: Two-phase locking techniques for concurrency control, concurrency control based on timestamp ordering.
Database Recovery Techniques: Recovery concepts; Shadow paging; The ARIES recovery algorithm.
Indexing Structures for Files and Physical Database Design: Single level and multi-Level indexing; Dynamic multi-level indexing using B-trees and B+ trees.

PRACTICES:

- Design and Development of company database and expressing Nested queries using SQL.
- Design and Development of student database and specifying queries using set operations.
- Design and Development of sailor's database and specifying queries using different types of JOINs.
- Implementation of PL/SQL programs with Control Structures.
- Implementation of PL/SQL programs with Procedures.
- Implementation of PL/SQL programs with Function.
- Implementation of PL/SQL programs with Triggers.

- Creation and dropping of VIEWS.
- Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values. F = {CH -> G, A -> BC, B -> CFH, E -> A, F -> EG} is a set of functional dependencies (FDs) so that F+ is exactly the set of FDs that hold for R. How many candidate keys does the relation R have?
- Apply various DCL and TCL constructs of SQL on Relational Database.

SKILLS:

➢ Develop E-R model for real life applications.
➢ Design of relational databases for real world applications.
➢ Devise queries using relational algebra and SQL.
➢ Analyze transaction processing, concurrency control and recovery techniques.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

CO No	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Develop an E-R model for real life applications.	Apply	1	1,10
2	Express queries using database tools like Oracle, DB2, MYSQL.	Apply	2	5,10
3	Devise queries using Relational Algebra and SQL.	Analyze	2	2
4	Design and normalize databases for real time applications.	Create	1	1,3

TEXT BOOKS:

1. Ramez, Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.
2. Raghu Rama Krishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, Tata McGraw Hill, 2013.

REFERENCE BOOKS:

1. Abraham Silberschatz, Henry F.Korth and S.Sudarshan, "Database System Concepts", 7th edition, Tata Mc Graw Hill,2019.
2. Allen G. Taylor "Database Development for Dummies" 1st Edition, 2011
3. C. J. Date "Introduction to Database Systems" 7th Edition, Addison Wesley, 2003.

https://www.youtube.com/watch?v=lDpB9zF8LBw

Hours per week:

L	T	P	C
2	0	4	4

PREREQUISITECOURSE: OOPs through JAVA.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers the concepts of web development like static and dynamic web page design and provides internet programming knowledge, web servers, application servers, and design methodologies using object-oriented concepts. The objective of this course is to build web applications using JSP, PHP, Angular JS, and Node JS with a client and server-side scripting technologies that span multiple domains.

MODULE - 1

UNIT-1   **8L+0T+16P=24 hours**
INTRODUCTION:
HTML: Creating structured documents, Links and navigation, Tables, Forms, and Frames.
HTML 5: Introduction to HTML5, The HTML5 Canvas, HTML5 audio and Video;
CSS: Cascading Style Sheets, CSS Properties.
Java Script: Learning Java Script- how to add scripts to your page, DOM, variables, operators, functions, conditional statements, Looping, Events, Built-in objects, form and regular expression validation.

UNIT-2   **8L+0T+16P=24 hours**
JDBC AND JSP:
JDBC: What is JDBC, system requirements, types of JDBC Drivers, creating database tables, connecting to a database, executing SQL statements, processing result sets, and making changes to a result set.
JSP: JSP Processing, Generating Dynamic Content using Scripting Elements, Implicit JSP Objects, Sharing Data between JSP pages, JSP application design with JDBC.

PRACTICES:
▪ Design a webpage having four frames named a) Top, b) Center, c) Bottom and d) Left. The top frame should contain the company logo and title. The bottom frame should contain copyright information. The left frame should contain various links like Home, Products, Services, Branches, About, etc., When clicked on respective links, the content should display on the center frame.
▪ Design a catalog page that should contain the details of all the books available on the website in a table. The details should contain the following: a) Snapshot of Cover Page b) Author Name c) Publisher. d) Price. e) Add to cart button.
▪ Design a timetable schedule for your current semester using the Table tag.
▪ Design a HTML page for Student Registration Form using Form Elements that includes Form, input-text, password, radio, checkbox, hidden, button, submit, reset, label, text area, select, option and file upload.
▪ Design a HTML web page with at least two <h1>, two images, two buttons, and appropriate CSS to display,
    o All <h1> with font – size 12pt, and bold in Verdana font using Inline CSS.
    o All <img> with border color yellow, thickness 10px using Document Level CSS.

- o All <inputtype='button'> should change background color to red on mouse over them using External CSS.
- Design a HTML page having a text box and four buttons viz Factorial, Fibonacci, Prime and Palindrome. When a button is pressed an appropriate java script function should be called to display the following:
  - o Factorial of that number.
  - o Fibonacci series up to that number.
  - o Prime numbers up to that number.
  - o Is it palindrome or not?

- Design a web page that contains a color pallet, when the user moves the mouse to the particular area, then it changes the background color of the web page.
- Design a registration page to validate the following fields using Java Script.
  - o Make sure the user name starts with an upper case letter
  - o The user name must have at least one digit
  - o Ensure that Email is valid
  - o Ensure that thepasswordlengthisbetween8to20characters
  - o Make sure the password contains at least one upper case letter, one lower case, and one special character exclude [. (dot), ,(comma), ;(semicolon), : (colon)].

- Design a web page to display the videos on-page, on user selection using frames and HTML5 tags.
- Design a web page to display different types of objects using HTML5 Canvas.
- Design a web application to validate entered username and password through JDBC connection program and display user information on successful login and provide profile editing option to the user. Else display an error message.
- Develop a JSP application to create a user on successful signup and update user information on successful login and display user information on the home screen and provide a logout button.
- Make an HTML form that collects the last name. Send the name to JSP page. If there is an employee with that last name, show full details of him or her (just show the first employee if there are multiple people with the same name). If there is no employee with that last name, say "no employee records available."

MODULE-2
UNIT–1   **8L+0T+16P=24 hours**
PHP: Introduction to PHP, Expressions, and control flow in PHP, functions and objects, Arrays, Accessing MySQL using PHP, Form Handling, Cookies, Sessions, and Authentication.

UNIT–2   **8L+0T+16P=24 hours**
ANGULAR AND NODE JS:
Angular JS: Introduction, Expressions, Modules, Directives, Controllers, Filters, Events, Forms, Form Validation.
Node JS: Introduction, Setup Dev Environment, Modules, Node Package Manager, Creating Web server, File System, Events, Express.js, Accessing MySQL from Node.js.

PRACTICES:
- Design a web page using PHP, upload image into web page and display image, when user clicking on view button.
- Design a personal Information form, Submit & Retrieve the form data using $_GET(),

$_POST() and $_REQUEST() Variables.
- Design a login page to validate username and password through MySQL. If login is successful display user information on home page and modify user information on edit page using sessions. When user logged out, destroy all user-related sessions.
- Design a web page to accept payment data from user and do the payment, on successful payment display details on the screen. A Session should be set while doing payment up to 10 minutes after that link/payment page should be destroyed irrespective of user payment.
- Design a web application to validate user registration page using Angular JS.
- Design a search engine using Angular JS. On key press, display data on web page.
- Design a web page to validate user name and password using: Node.js and PHP. When user clicks on login button, server checks the data availability in data base. If the data matches a successful login page is returned. Otherwise, a failure message is shown to the user.
- Design a web application to display the active duration of the user, i.e., time between login and logout.

SKILLS:

➢ Perform client-side validation using Java Script and Angular JS.
➢ Store and retrieve data using Node JS.
➢ Generate dynamic web pages using JSP and PHP.
➢ Develop a web application or website for any real-time requirements.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Usage of HTML, HTML5, CSS, Java Script, and PHP in web application development.	Apply	1, 2	1
2	Apply Angular JS features for form validation and Node JS, and JDBC concepts to perform database operations from web pages.	Apply	1,2	1
3	Analyse the suitability of Node JS and JSP technologies to build solutions for real-world problems.	Analyse	2	2
4	Design and develop three tier web applications using JSP, Node JS, Angular JS, and PHP.	Creating	2	3

TEXT BOOKS:

1. Jon Duckett, "Beginning Web Programming with HTML, XHTML, and CSS", 2nd Edition, Wiley Publishing, Inc, 2008.
2. Robin Nixon, "Learning PHP, MySQL & JavaScript WITH JQUERY, CSS & HTML5", 4th Edition, O'Reilly, 2015.

REFERENCE BOOKS:

1. Paul Deitel, Harvey Deitel, Abbey Deitel, "Internet & World Wide Web How to Program", 5th Edition, Pearson Education, 2012.
2. Kishori Sharon, "Java APIs, Extensions and Libraries with JavaFX, JDBC, jmod, jlink,

Networking and the process API", 2nd Edition, Apress, 2018.

3. Marty Hall and Larry Brown, "Core Servlets and Java Server pages Vol.1: Core Technologies", 2nd Edition, Pearson, 2004.
4. Brad Dayley, Brendan Dayley, and Caleb Dayley, "Node.js, Mongo DB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications," 2nd Edition, Pearson Education, 2018.
5. ManuelKiessling, "The Node Craftsman Book", Packt Publisher, 2017.
6. Larry Ullman, "PHP for the Web: Visual QuickStart Guide", 4th Edition, Pearson Education, 2011.
7. Steve Prettyman, "Learn PHP 7 Object Oriented Modular Programming using HTML5, CSS3, JavaScript, XML, JSON, and MySQL", 1st edition, Apress, 2015.
8. Adrian W. West and Steve Prettyman, "Practical PHP 7, MySQL 8, and MariaDB Website Databases: A Simplified Approach to Developing Database-Driven Websites", 1st edition, A Press, 2018.

https://www.dreamstime.com/web-development-coding-programming-internet-technology-business-concept-web-development-coding-programming-internet-technology-image121903546

22CS905-MOBILE APPLICATION DEVELOPMENT

<div align="right">Hours per week:</div>

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: OOPs through Java, DDL & DML Commands – DBMS.

COURSE DESCRIPTION AND OBJECTIVES:

This course guides the student in designing and building a mobile application using Android™. The main objective of this course is to let the student learn basic Android programming concepts while building a variety of apps, starting with basic to making use of advanced concepts.

MODULE-1

UNIT-1   **8L+0T+16P=24Hours**

INTRODUCTION:

Introduction to Mobile Application Development- Mobile Applications and Device Platforms, Alternatives for Building Mobile Apps; Introduction to Android, Android versions, Android Architecture.

Application Development Process- Developers Workflow basics, Installing the Android SDK Tools; Anatomy of an Android Application.

Basic Building blocks - Activities, Services, Broadcast Receivers & Content providers; Intents & Fragments.

View Group- Layout: Linear Layout, Relative Layout, Frame Layout, Grid Layout, constraint Layout, Table Layout, and Absolute Layout.

UNIT-2   **8L+0T+16P=24Hours**

Views: Basic Views; Picker Views- Time Picker View, Data Picker View; List Views – List View, Spinner View; Scroll View.

Activities: Creating an activity, Understanding the activity life cycle using Log and Toast, applying styles and themes to an activity, and hiding the activity title.

Linking Activities using Intents: Introduction to Intents and its types with examples, passing data between activities with intents, Activity Navigation- Implement up navigation with parent activities.

Fragments: Introduction to Fragment, the life cycle of a fragment, Adding fragments dynamically, Interaction between fragments.

PRACTICES:

- Setting up Android Studio:
    a. Installing Android Studio
    b. Select an empty activity to simulate the "Welcome App" Using Android Studio.
    c. Exploring the interface of the Android Studio to understand the Project Structure.
- Develop an Android application using controls like Button, TextView, and EditText for designing a calculator having basic functionality like Addition, Subtraction, Multiplication, and Division.
- Design the **HelloToast app**: The **HelloToast app** consists of two Button elements and one TextView. When the user taps the first Button, it displays a short message (a Toast) on the screen. Tapping the second Button increases a "click" counter displayed in the TextView, which starts at zero.
- Design **Silent Model Toggle application**: This app allows the user to toggle the ringer mode on the phone by simply pressing a button.
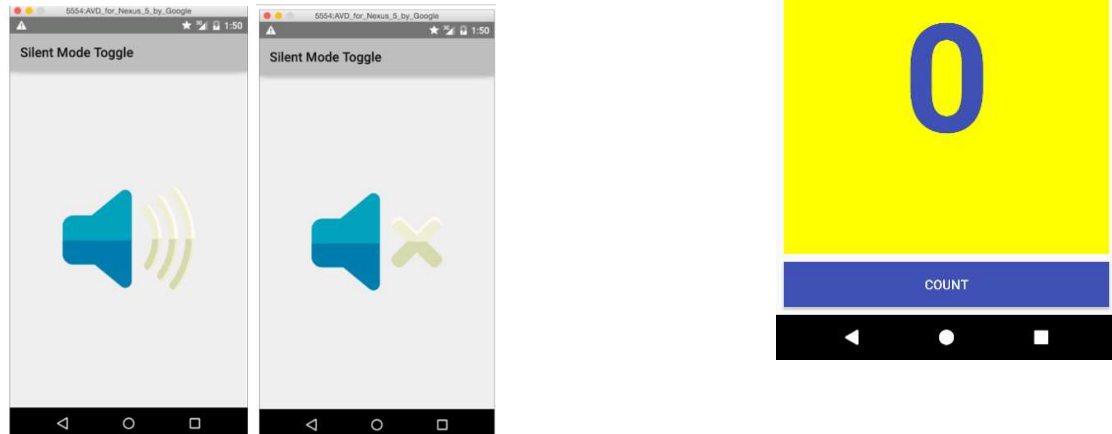
- In this assignment, students will create and build an app called Two Activities. Students will build the app in four stages.
    a. In the first stage, you create an app whose main activity contains one button, Send. When the user clicks this button, your main activity uses an intent to start the second activity.
    b. In the second stage, you add an EditText view to the main activity. The user enters a message and clicks Send. The main activity uses an intent to start the second activity and sends the user's message to the second activity. The second activity displays the message received.
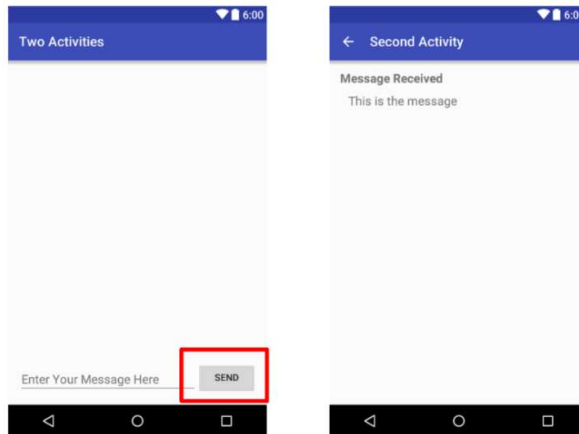
c. In the final stage of creating the Two Activities app, you add an EditText and a Reply button to the second activity. The user can now type a reply message and tap Reply, and the reply is displayed on the main activity. At this point, you use an intent to pass the reply from the second activity to the main activity.

d. Implement all the Activity lifecycle call back methods to print messages to logcat when those methods are invoked. These log messages will allow you to see when the Activity lifecycle changes state, and how those lifecycle state changes affect your app as it runs.
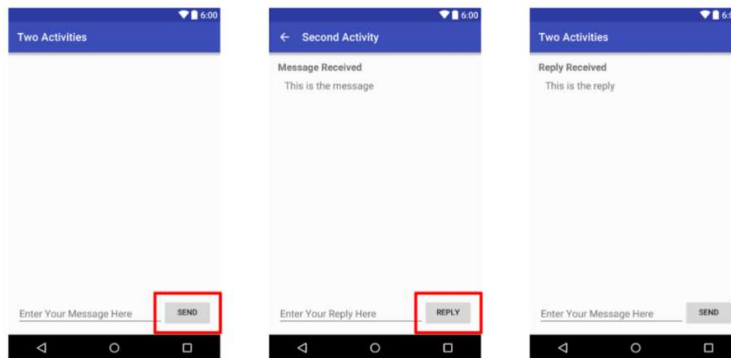
Main activity ⟶ Second activity ⟶ Back to Main activity

- Design an application with **implicit intents**: Create a new app with one Activity and three options for actions: open a website, open a location on a map, and share a snippet of text. All the text fields are editable (EditText) but contain default values.
- Design **Droid Café**: In this practical, the student will create and build a new app starting with the Basic Activity template that imitates a dessert-ordering app. The user can tap an image to perform an action—in this case, display a Toast message—as shown in the figure below. The user can also tap a shopping cart button to proceed to the next Activity.

    d. Experiment with the android: inputType attribute for EditText elements. You add EditText elements for a person's name and address and use attributes to define single-line and multiple-line elements that make suggestions as you enter text. You also add an EditText that shows a numeric keypad for entering a phone number.

    e. Other types of input controls include interactive elements that provide user choices. You add radio buttons to Droid Cafe for choosing only one delivery option from several options. You also offer a spinner input control for selecting the label (Home, Work, Other, Custom) for the phone number.
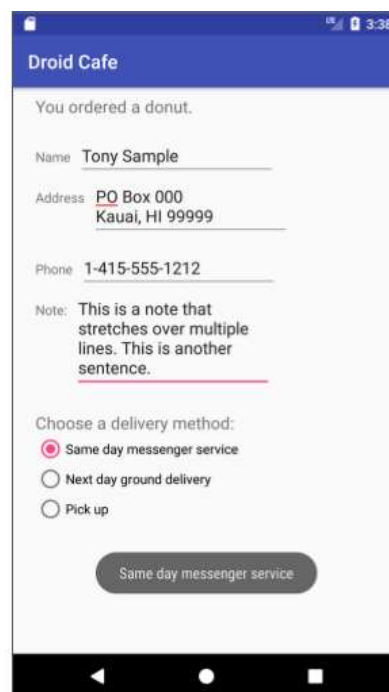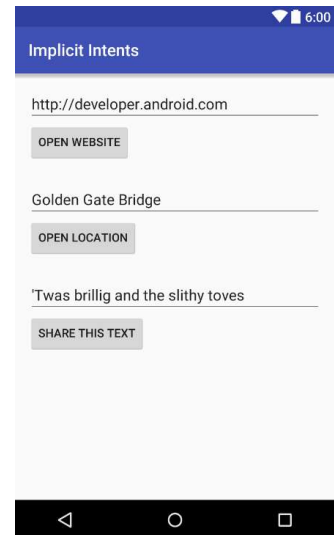
MODULE–2

UNIT–1   **8L+0T+16P=24 hours**

CREATING A FEATURE-RICH APPLICATION:

Creating a Feature-Rich Application: Display Orientation – Anchor Views, resizing and repositioning Views, Managing changes to Screen Orientation; Notifications; Action bar; Dialog box; Adapters- Array Adapters and Base Adapters; Recycler View.

UNIT-2   **8L+0T+16P=24 hours**

SQLite DATABASE:

SQLite Database – Creating the database, Dealing with CRUD;

Firebase- Getting Started with Firebase, Add Firebase to your Android project, Firebase database – Introduction to Firebase database, set up Firebase Real-time Database for Android, Read and Write Data on Android; **Publish the App in Play store.**

PRACTICES:

- Design an application to keep data when the user rotates the device, and when the screen is rotated: When the user rotates the device, Android will normally destroy and re-create the current Activity. You want to keep some data across this cycle, but all the fields in your Activity are lost during it.
- Create a Splash Screen for the existing project- Droid Café from Module- 1.
- Design a News App- Consider the following screen as reference:
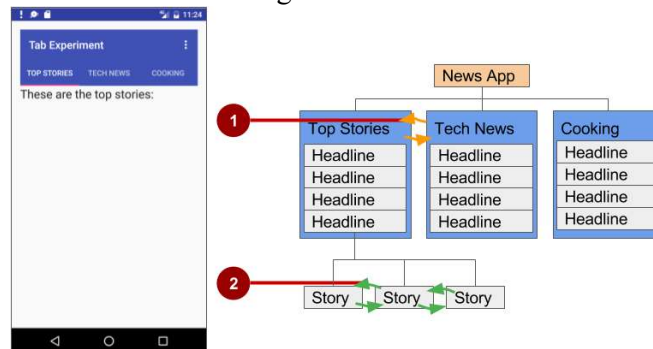
NOTE: Use Recycle View to display the news under each category.

- Adding more features to Droid Café: In the previous assignments, you created an app called Droid Café, using the Basic Activity template. This template also provides a skeletal options menu in the app bar at the top of the screen.
  a. Update that menu option as shown in the following images:
  b. Add notification option: The app must notify the user when the user places the order.
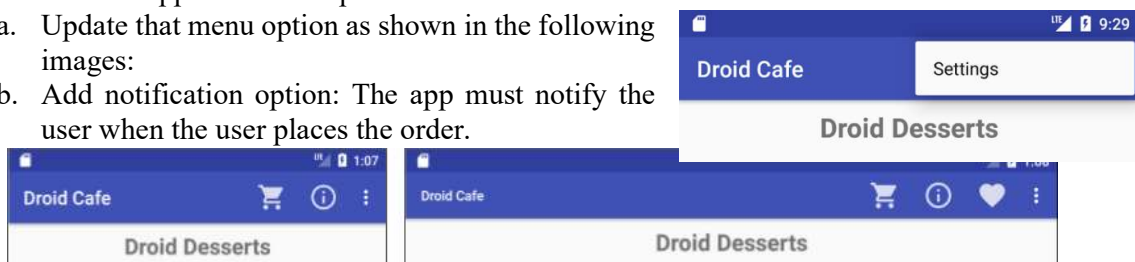
- Provide user authentication for the Droid Café using Firebase – Authentication or SQLite.
- Save all the user preferences in the Firebase Real time Database to fetch whenever required.

SKILLS:

➢ Design mobile applications for user requirements.
➢ Use of suitable advanced components to design mobile apps.
➢ Utilization of activities, intents, layouts, and views for content.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

CO No.	Course Outcomes	Blooms Level	Module No	POs
1	Apply views, intents, and fragments to an existing application.	Apply	1	2
2	Evaluate an existing app to enrich it with new features.	Evaluate	2	2,3
3	Analyse methods for storing, sharing, and retrieving data in an Android app.	Analyse	2	5
4	Design and publish a mobile app in the play store with a database forgiven real-time scenarios using modern tools- Android Studio, and Firebase.	Create	2	5,10

TEXT BOOKS:

1. John Horton "Android Programming for Beginners: Build in-depth, full-featured Android apps starting from zero programming experience", 3rd Edition, 2021.
2. Wei-Meng Lee, "Beginning Android Application Development", 1st Edition, John Wiley & Sons, 2012.

REFERENCE BOOKS:

1. https://aws.amazon.com/mobile/mobile-application-development/
2. https://google-developer-training.github.io/android-developer-fundamentals-course-concepts/.
3. Michael Burton," Android App Development for Dummies ", 3rd Edition, A Wiley Brand, 2020.
4. Dawn Griffiths & David Griffiths, "Headfirst Android Development A Brain-Friendly Guide" 2nd Edition, O'Reilly, 2015.

https://www.tatvasoft.com.au/blog/mobile-application-development-methodology/

22CS906 - DESIGN AND ANALYSIS OF ALGORITHMS

Hours per week:

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Programming for problem solving, Discrete Mathematical Structures, Data Structures.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers the basic knowledge required to analyze the asymptotic performance of algorithms. In addition, this course provides the knowledge required to solve different problems using suitable design strategies such as the greedy method, divide and conquer, dynamic programming, backtracking and branch & bound. This course helps to understand the impact of the choice of data structures and algorithm design strategies on the performance. This course also provides the understanding of advanced graph applications and throws light on tractable and intractable problems.

MODULE-1

UNIT-1   **6L+6T+6P=18 Hours**
INTRODUCTION:
Algorithm, Pseudo-code for expressing algorithms, Performance analysis – space and time complexity; Asymptotic notation - big oh notation, Omega notation, Theta notation and little oh notation; Analysis of recursive algorithms through recurrence relations- substitution method, Recursion tree method, Masters Theorem.
Disjoint sets: Disjoint set operations, Union and find algorithms.

UNIT-2   **10L+10T+10P=30 Hours**
DIVIDE & CONQUER AND GREEDY METHOD:
Divide and Conquer: General method, Applications - Binary search, Quick sort, Merge sort and Strassen's matrix multiplication.
Greedy Method: Applications - job sequencing with deadlines, Knapsack problem, Minimum cost spanning trees.

PRACTICES:

- Sort a given set of elements using the following methods and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n inputs. The elements can be read from a file or can be generated using the random number generator.
  a. Quick sort   b. Merge sort

- Search for a given set of elements using the following methods and determine the time required to search the given element. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus no. of elements. The elements can be read from a file or can be generated using the random number generator.
  a. Linear Search   b. Binary Search

- Implement the following using divide and conquer approach.
  - To multiply two given square matrices.
  - To multiply two given square matrices using Strassen's matrix multiplication.

- Design the Algorithm to solve Job sequencing with deadlines problem and Analyze its time complexity. Implement the above algorithm using Greedy method.

- Design the Algorithm to solve fractional Knapsack problem using Greedy method. Analyze the time complexity and implement the above algorithm.

- Design the Algorithm to find minimum spanning tree and its cost for an undirected graph. Analyze the time complexity and implement the above algorithm.

MODULE-2

UNIT-1   10L+10T+10P=30 Hours

DYNAMIC PROGRAMMING AND BACKTRACKING:

Dynamic Programming: General method, Applications - optimal binary search trees, Matrix chain multiplication, 0/1knapsackproblem, All pairs shortest path problem, Travelling sales person problem.

Backtracking: General method, Applications - N-Queen problem, Sum of subsets problem, Graph colouring and Hamiltonian cycles.

UNIT-2   6L+6T+6P=18 Hours

BRANCH & BOUND AND P, NP, NP - HARD AND NP-COMPLETE:

Branch and Bound: General method, Applications- Travelling sales person problem, 0/1 knapsack problem using LC branch and bound solution and FIFO branch and bound solution.

P, NP, NP - HARD and NP-Complete: Basic Concepts - Non-Deterministic Algorithms - The Classes NP-Hard and NP Complete- NP Hard Problems- Clique Decision Problem-Cook's Theorem.

PRACTICES:

- Design the Algorithm to find all pairs shortest path problem by using dynamic programming approach. Analyze its time complexity and implement the above algorithm.
- Design the Algorithm to find optimal binary search tree and its cost by using dynamic programming approach. Analyze its time complexity and implement the above algorithm.
- Design the Algorithm to find optimal order of matrix chain multiplication and its cost using dynamic programming approach. Analyze its time complexity and implement the above algorithm.
- Design the Algorithm to find optimal route for travelling sales person problem and its cost by using dynamic Programming approach. Analyze its time complexity and implement the above algorithm.

- Design the Algorithm to solve N-queens problem by using backtracking approach and Analyze its time complexity. Implement the above algorithm.
- Design the Algorithm to solve sum of subsets problem using backtracking approach and Analyze its time complexity. Implement the above algorithm.
- Design the Algorithm to solve 0/1 Knapsack problem using Branch and Bound method. Analyze the time complexity and Implement the above algorithm.

SKILLS:

- Analyze the given algorithm concerning space and time complexities and compare it with other algorithms.
- Develop algorithms for solving problems using divide and conquer, greedy, dynamic programming, backtracking and branch & bound techniques.
- Application of existing design strategies to solve real-world problems.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply greedy algorithm Strategy for suit able problems and argue the correctness of such algorithms with respect to the global optimization.	Apply	1	1, 2,3, 5, 12
2	Apply the dynamic programming paradigm and identify the kind of problem best suited to solve using dynamic programming.	Apply	2	1, 2, 3, 5, 12
3	Compare and contrast the design principles of branch and bound with backtracking strategy.	Apply	2	1, 2,3,5, 12
4	Analyze the efficiency of a given algorithm using time and space complexity theory. Understanding algorithmic design strategy like divide and conquer approach.	Analyze	1	1, 2, 12
5	Investigate computational complexity of different class of problems.	Analyze	2	1, 2,4,12

TEXT BOOKS:
1. Ellis Horowitz, SatrajSahni and Rajasekharan, "Fundamentals of Computer Algorithms", 2nd Edition, Galgotia publications, 2006.
2. Thomas H. Coremen, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithm", 2nd Edition, MIT press Ltd., 2014.

REFERENCE BOOKS:

1. Anony Levitin, "Introduction to Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2016.
2. Donald E. Knuth, "The Art of Computer Programming", 2nd Edition, Addison Wesley Publishing Company, 1998.
3. Ronald L. Graham, Donald E. Knuth and Oren Patashnik, "Concrete Mathematics", 2nd Edition, Addison wesley Publishing Company,1998.

4. Dasgupta, Papadimitriou and Vazirani,"Algorithms", 1st Edition, McGraw-Hill publishers, 2008.
5. Weiss, "Data Structures and Algorithm Analysis", 1st Edition, Addison-Wesley Publishing Company, 2016.

https://www.facebook.com/Design-and-Analysis-of-Algorithms-1553902878155564/
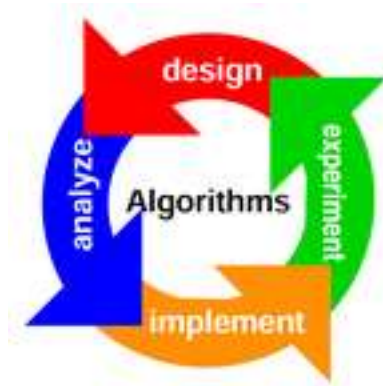
22CS907 – OPERATING SYSTEMS AND SHELL PROGRAMMING

Hours per week:

L	T	P	C
2	2	2	4

PRE REQUISITE KNOWLEDGE: Knowledge of computers fundamentals, Computer organization & Digital logic and its design.

COURSE DESCRIPTION AND OBJECTIVES:
This course aims at concepts and principles of Operating Systems, its overall responsibility inacting as an interface between the system's hardware components and the user. Further, it also helps students to understand the different scheduling policies, process synchronization mechanisms, deadlock handling mechanisms and memory management techniques.

MODULE-1

UNIT-1   **10L+10T+10P=30 Hours**

LINUX FILE SYSTEM & PROCESS SCHEDULING:
Introduction to LINUX File System: The LINUX file System, File System Hierarchy, File system Commands, File Attributes, File Permissions.
Filters: cmp, comm, diff, head, tail, find, cut, paste, sort, uniq.
Regular Expressions: grep, egrep, fgrep, Sed- line addressing, context addressing, text editing, substitution.
Introduction to Operating System: What Operating System do; Operating System Structure; Process concept-overview, Process Scheduling, Operations on Process; Inter Process Communication; Threads;
Process (CPU) Scheduling-Scheduling Criteria, Scheduling Algorithms; Multiple-Processor scheduling;

UNIT-2   **6L+6T+6P=18Hours**

PROCESS SYNCHRONIZATION & DEADLOCKS:
Process Synchronization: The critical-section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.
Deadlocks: Deadlock characterization; Methods of handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery.

PRACTICES:
- Use the cat command to create a file containing the following data. Call it mytable.txt usetabsto separate the fields.

1425	ravi	15.65
4320	ramu	26.27
6830	sita	36.15
1450	raju	21.86

  a.   Use the cat command to display the file, mytable.txt.
  b.   Use the vi command to correct any errors in the file, mytable.txt.
  c.   Use the sort command to sort the file mytable.txt according to the first field.
  d.   . Call the sorted file mytable.txt (same name)
  e.   Print the file mytable.txt.
  f.   Use the cut & paste commands to swap fields 2and 3mytable.Call it mytable.txt (same name)

g.   Print the new file, mytable.txt.

- Write a shell script that takes a command -line argument and reports on whether it is directory, a file, or something else.
- Write a shell script that accepts one or more file name as arguments and convertsall of them to uppercase, provided they exist in the current directory.
- Write a shell script that displays a list of all the files in the current directory to which the user has read, write and execute permissions.
- Write a shell script that computes the total and average marks of a student according to the following;
    o   If average marks ≥ 69 then result is - Distinction.
    o   If average marks ≥ 59 and ≤ 70 then result is – First Class.
    o   If average marks ≥ 49 and ≤ 60 then result is – Second Class
    o   If average marks ≤ 50 then result is ―Pass.
    o   Note that any subject marks ≤ 40then result is - Fail.
- Accept student name and six subject marks through the keyboard.
- Write an interactive file-handling shell program. Let it offer the user the choice of copying, removing, renaming, or linking files. Once the user has made a choice, have the program ask the user for the necessary information, such as the file name, new name and so on.
- Write a shell script, which receives two file names as arguments. It should check whether the two file contents are same or not. If they are same then second file should be deleted.
- Write a shell script that accepts a file name starting and ending line numbers as arguments and displays all the lines between the given line numbers.
- Write a shell script that deletes all lines containing a specified word in one or more files supplied as arguments to it.
- Implementation of new process creation and its communications.
- Implement of thread creation and deletion.
- Implementation of FCFS scheduling.
- Implementation of SJF and RR Scheduling.
- Implementation of producer consumer problem.
- Implementation of Banker's algorithm for Dead lock avoidance.

MODULE-2

UNIT-1   **8L+8T+8P=24 Hours**

MEMORY MANAGEMENT:

Memory Management: Basic concept of memory management, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation.

Virtual Memory Management: Demand Paging, Page Replacement: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU), Least Recently used (LRU), Allocation of Frames.

SECONDARY STORAGE STRUCTURE:

Secondary Storage Structure: Overview of mass-storage structure, disk structure, disk scheduling;

File System Interface - File concept, Access Methods, Directory & Disk Structure, File-System Mounting, File Sharing, Protection; File-system structure.

File System Implementation- Directory implementation, Allocation Methods, Free Space Management.

PRACTICES:
- Assume that you have a page-reference string for a process with m frames (initially all empty).The page-reference string has length p, and n distinct page numbers occur in it.
  a) What is a lower bound on the number of page faults?
  b) What is an upper bound on the number of page faults?
- Consider the following page-replacement algorithms. Rank these algorithms on a five-point scale from "bad" to "perfect" according to their page-fault rate. Separate those algorithms that suffer from Belady's anomaly from those that do not.
  a) LRU replacement.
  b) FIFO replacement.
  c) Optimal replacement.
  d) Second-chance replacement.
- Consider the page reference string: 1, 2, 3, 4,2, 1, 5, 6, 2, 1, 2, 3,7, 6, 3, 2, 1, 2, 3, 6.
  How many page faults would occur for the following replacement algorithms, assuming one, two, three, four, five, six, and seven frames? Remember that all frames are initially empty, so your first unique pages will cost one fault each.
  • LRU replacement.
  • FIFO replacement.
  • Optimal replacement.
- How many page fault soccur for your algorithm for the following reference string with four page frames? 1, 2, 3,4, 5, 3, 4, 1, 6,7, 8, 7, 8, 9, 7, 8,9, 5, 4, 5,4, 2.
- What is the minimum number of page faults for an optimal page replacement strategy for the reference string above with four page frames?
- Consider a demand-paged computer system where the degree of multiprogramming is currently fixed at four. The system was recently measured to determine utilization of the CPU and the paging disk. Three alternative results are shown below. For each case, what is happening?

  a) Can the degree of multiprogramming be increased to increase the CPU utilization? Is the paging helping?
  b) CPU utilization 13 percent; disk utilization 97 percent.
  c) CPU utilization 87percent; disk utilization 3 percent.
  d) CPU utilization 13 percent; disk utilization 3 percent.

- Implementation of Disk scheduling algorithm–FCFS.
- Implementation of Disk scheduling algorithm–SSTF and SCAN.

SKILLS:

- ➢ Manage open-source operating systems like Ubuntu, Fedora etc.
- ➢ Understand the concepts of Processes scheduling and File Systems.
- ➢ Identification of different disk scheduling methodologies.

COURSE OUTCOMES:

Up on completion of the course, the student will be able to achieve the following out comes:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1.	Apply the concepts of process scheduling algorithms and process synchronization techniques to derive the efficiency of resource utilization.	Apply	1	1, 2, 3, 5, 12
2.	Apply the concepts of file system interface and implementation.	Apply	1,2	2,5
3.	Classify the basic concepts of operating system and explore Linux ecosystem.	Analyze	1	1
4.	Analyze the requirements for attempting Operating systems principles.	Analyze	1,2	1,2,12
5.	Design the various memory management schemes For a given scenario.	Create	2	3,5

TEXTBOOKS:

1. Sumitabha Das, Unix concepts and applications, TMH Publications, 4th Edition, July 2017.
2. B.A. Forouzan & R.F. Giberg, - Unix and shell Programming, Thomson, 1st Edition, New Delhi, 2003.
3. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley & SonsInc, 2013.

REFERENCE BOOKS:

1. Richard. Stevens and Stephen A. Rago, "Advanced Programming in the Unix Environment", 3rd Edition, Addison-Wesley, 2013.
2. William Stallings, "Operating Systems-Internals and Design principles" PHI, 7th Edition, 2012.
3. Gary J. Nutt. Addison-Wesley, "Operating Systems: A Modern Perspective", 2nd Edition, Aug 2001.

https://www.123rf.com/stock-photo/operating_system.html

Hours per week:

L	T	P	**C**
3	0	2	4

PREREQUISITE KNOWLEDGE: JAVA programming and UNIX commands.

COURSE DESCRIPTION AND OBJECTIVES:

This course focuses on imparting knowledge about various protocols involved in LANs and WANs. In addition, it gives a good foundation on different protocols such as data link protocols, internet protocols, and transport protocols present in the respective layers of the data communication system.

MODULE-1

UNIT-1   **8L+0T+6P = 14 hours**

INTRODUCTION TO COMPUTER NETWORKS AND INTERNET:

Understanding of network and Internet, the network edge, the network core, Understanding of Delay, Loss and Throughput in the packet switching network, protocols layers and their service model, History of the computer network.

UNIT-2   **16L+0T+10P = 26 hours**

APPLICATION LAYER & TRANSPORT LAYER:

Principles of computer applications, Web and HTTP, E-mail, DNS, Socket programming with TCP and UDP.

Introduction and transport layer services, Multiplexing and Demultiplexing, Connectionless transport (UDP), Principles of reliable data transfer, Connection-oriented transport (TCP), Congestion control.

PRACTICES:

- Install Network Simulator 2/3. Create a wired network using dumbbell topology. Attach agents, generate both FTP and CBR traffic, and transmit the traffic. Vary the data rates and evaluate the performance using metric throughput, delay, jitter and packet loss.
- Create a static wireless network. Attach agents, generate both FTP and CBR traffic, and transmit the traffic. Vary the data rates and evaluate the performance using metric throughput, delay, jitter and packet loss.
- Create a mobile wireless network. Attach agents, generate both FTP and CBR traffic, and transmit the traffic. Vary the data rates and evaluate the performance using metric throughput, delay, jitter and packet loss.

- Implementation of one-way and two-way communication using TCP / UDP.
- Hello command is used to know whether the machine at the other end is working or not. Echo command is used to measure the round trip time to the neighbour. Implement Hello and Echo commands using JAVA.

MODULE-2

UNIT-1   **12L+0T+8P = 20 hours**
NETWORK LAYER:
Introduction to forwarding and routing, Network Service models, Virtual and Datagram networks, study of router, IP protocol and addressing in the Internet, Routing algorithms, Broadcast and Multicast routing.

UNIT-2   **12L+0T+8P = 20 Hours**
THE LINK LAYER AND LOCAL AREA NETWORKS:
Introduction to link layer services, error detection, and correction techniques, Multiple access protocols, addressing, Ethernet, switches, and VLANs.

PRACTICES:
- Find all the IP addresses on your network using Unicast, Multicast, and Broadcast on your network.
- Use Packet tracer software to build network topology and configure using Distance vector routing and Link State routing protocols.
- Study different types of Network cables (Copper and Fiber) and prepare cables (Straight and Cross) to connect two or more systems.
  a. Use a crimping tool to connect jacks.
  b. Use a LAN tester to connect the cables.
  c. Install and configure Network Devices: HUB, Switch and Routers (Consider both manageable and non-manageable switches. Perform logical configuration of the system and set the bandwidth of different ports).
  d. Install and Configure Wired and Wireless NIC and transfer files between systems in Wired LAN and Wireless LAN. Consider both ad-hoc and infrastructure modes of operation.
- Apply the commands such as Ping, Tracert, Ipconfig, pathping, telnet, FTP, getmac, ARP, Hostname, Nbtstat, netdiag, and Nslookup to solve various problems.

SKILLS:

- Establish local area networks with different topologies.
- Design of new routing protocols.
- Network troubleshooting such as installing network interface card drivers, setting IP addresses, subnet masking, etc.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Build the basic concepts of Network hardware, software and reference models.	Apply	1	1, 2, 12
2	Implement various protocols with modern tools.	Apply	1	1, 2, 3, 5, 12

3	Demonstrate various protocols involved in data link layer operations.	Apply	2	1,2, 5
4	Apply different protocols to perform end-to-end delivery and interaction with users.	Analyze	2	1, 2, 12
5	Analyze various design issues, protocols and functionalities of network layer.	Analyze	2	1, 2, 12
6	Evaluate different physical layer media and switching methods.	Evaluate	1	1, 2, 5, 12

TEXT BOOKS:
1. Kurose and Ross, "Computer Networking- A Top-Down approach", 6th Edition, Pearson, 2017.
2. Behrouz Forouzan, "Computer Networks- A Top-Down approach", McGraw Hill, 2014.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum, "Computer Networks", 5th edition. Pearson Education, 2014.
2. Behrouz A. Forouzan, "Data communications and Networking", 5th edition, TMH, 2017.
3. William Stallings, "Data and Computer Communications", 10th edition, Pearson Education, 2017.
4. Fred Halsall, "Computer Networking and the Internet", 5th edition, Addison Wesley, 2005.

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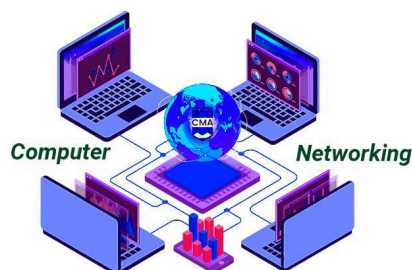
MINOR ON CYBER SECURITY
Offered by Department of Computer Science and Engineering

Engineering Graduates with the ability to monitor security of organizations's IT infrastructure, evaluate security threats and protect data from cyber-attacks are in high demand across the globe as all devices and data are vulnerable to cyber - attacks. Hence, there is a need to build talent that solves cyber-security problems with the latest and most on-demand Cyber security skills. As the need for cyber security professionals has been growing rapidly, a cyber security minor is being offered to students of all disciplines to enhance job opportunities in the field of cyber security.

Through this minor programme, students will acquire the knowledge rto protect organization's networks and data, and the skills to evaluate the security threats and build solutions. This minor covers the courses on Cryptography, Network Security, Etnical Hacking, Digital Forensics and Blockchain.

Course Code	Course Title	L	T	P	C
22CY901	Introduction to Block chain Technology	2	0	4	4
22CY902	Introduction to Digital Forensics	2	0	4	4
22CY903	Fundamentals of Security	3	2	0	4
22CY904	Fundamentals of Cryptography	3	0	2	4
22CY905	Tools and Techniques for Ethical Hacking	3	0	2	4
22CY906	Network Security	3	0	2	4
22CS909	Capstone Project	0	2	6	4

22CY901 – INTRODUCTION TO BLOCK CHAIN TECHNOLOGY

Hours per week:

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Cryptography and Network Security

COURSE DESCRIPTION AND OBJECTIVES:
This course covers the technical aspects of public distributed ledgers, block chain systems, cryptocurrencies, and smart contracts. Students will learn how these systems are built, how to interact with them, how to design and build secure distributed applications.

MODULE-1

UNIT-1   **8L+0T+16P=24 Hours**

INTRODUCTION TO BLOCKCHAIN:
Backstory of Blockchain, Blockchain, centralized vs Decentralized Systems, Layers of Blockchain, Importance of Blockchain, Blockchain Uses and Use Cases.

UNIT-2   **8L+0T+16P=24 Hours**
BLOCKCHAIN AND BITCOIN WORKING:
How Blockchain Works: Laying the Blockchain Foundation, Cryptography, Blockchain-Merkle trees, Properties of Blockchain Solutions, Blockchain Transactions, Distributed Consensus Mechanisms, Blockchain Applications-Scaling Blockchain.
How Bitcoin Works: The History of Money, Dawn of Bitcoin, Bitcoin- The Bitcoin
Blockchain, The Bitcoin Network- Bitcoin Scripts, Full Nodes vs. SPVs, Bitcoin Wallets.

PRACTICES:
- Generate the crypto material for the various participants in the bootstrapping network.
- Generate the genesis block for the Ordered node and start ordering service (solo node) in the bootstrapping network.
- Generated the configuration transaction block to create a new channel in the bootstrapping network.
- Sign the configuration block and create the new channel.
- Make peers of all the organizations join the channel that we created in the bootstrapping network.
- Setup Metamask in the System and Create a wallet in the Metamask with Test Network.
- Create multiple accounts in Metamask and perform the balance transfer between the accounts and describe the transaction specifications.
- Create a custom RPC network in Metamask and connect it with Ganache tool and transfer the ether between ganache account.

MODULE-2

UNIT-1   **8L+0T+16P=24 Hours**

ETHEREUM WORKING:
How Ethereum Works: From Bitcoin to Ethereum -Enter the Ethereum Blockchain-Ethereum Smart Contracts Ethereum Virtual Machine and Code Execution - Ethereum Ecosystem.

BLOCKCHAIN APPLICATION DEVELOPMENT:
Decentralized Applications - Blockchain Application, Development-Interacting with the Bitcoin Blockchain -Interacting Programmatically with Ethereum Interacting Programmatically with Ethereum—Creating a Smart Contract-Interacting Programmatically with Ethereum—Executing Smart Contract Functions-Blockchain Concepts Revisited-Public vs. Private Blockchains-Decentralized Application Architecture

PRACTICES:
- Install and Getting Started with the Bitcoin core client. Write a program to get a Bitcoin andcreate transaction.
- Write a program to implement application on bitcoin.
- Setup the Ethereum development environment. Generate addresses and create transaction.
- Write a program to implement application on Ethereum.
- Write a program to create smart contract.

SKILLS:

- List the differences between proof-of-work and proof-of-stake consensus.
- Send and read transactions in block-chain systems.
- Evaluate security, privacy, and efficiency of a given blockchain system.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the process involved in decentralization of Bit coin development.	Apply	2	3
2	Analyse the interaction process with blockchain systems.	Analyze	1	1, 2, 3
3	Design, build, and deploy smart contracts and distributed applications.	Analyze	1	1, 2, 3
4	Demonstrate the usage of Ethereum tool.	Create	2	1,3,5

TEXT BOOK:
1. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.

REFERENCE BOOKS:
1. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System, 2010.
2. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger," Yellow paper. 2014.
3. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, Bitcoin and Cryptocurrency. Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
4. Melanie Swan, Blockchain - Blueprint for a new economy, O'Reilly Media, Inc., 2015.
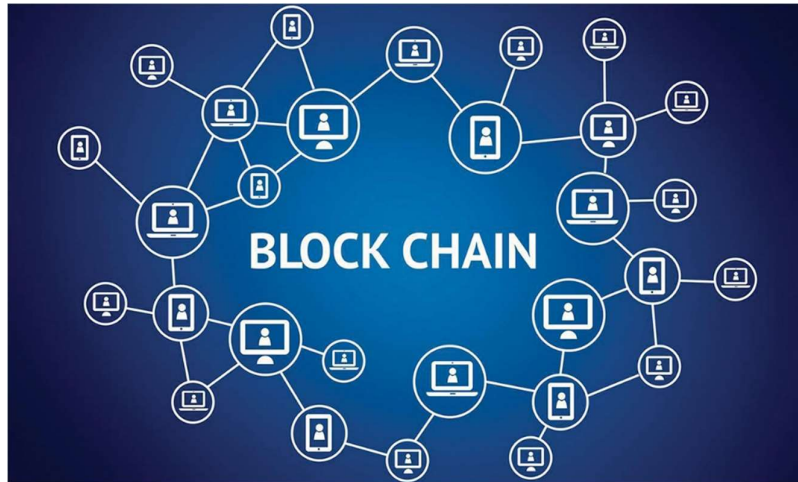
https://blogs.iadb.org/caribbean-dev-trends/en/blockchain-technology-explained-and-what-it-could-mean-for-the-caribbean/

22CY902 – INTRODUCTION TO DIGITAL FORENSICS

	L	T	P	C
Hours per week:	2	0	4	4

PREREQUISITE KNOWLEDGE: Cyber Security and Cyber Laws, Cryptography and Network Security

COURSE DESCRIPTION AND OBJECTIVES:
This course focuses on understanding forensic terminologies and approaches along with variety of tools used for digital forensic investigations. The objective of this course is to understand digital forensics and its usage in solving computer crimes. By end of the course, students will be able to identify improper usage of computer systems and legal concepts in digital forensic investigation stages.

MODULE-1

UNIT-1   **6L+0T+14P = 20 Hours**
INTRODUCTION;
Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues, Steps of computer forensics.
Understanding Computing Investigations: Procedure for corporate High-Tech investigations, understanding data recovery workstation and software, conducting and investigations.

UNIT-2   **10L+0T+18P = 28 Hours**
DATA ACQUISITION:
Understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

PRACTICES:
- Recover Deleted Files using Forensics Tools.
- Study the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt.
- Extract Exchangeable image file format (EXIF) Data from Image Files using Exif reader
- Software How to make the forensic image of the hard drive using EnCase Forensics.
- Restoring the Evidence Image using EnCase Forensics.

MODULE-2

UNIT-1   **6L+0T+14P = 20 Hours**
PROCESSING CRIMES AND INCIDENT SCENES:
Securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.

UNIT-2   **10L+0T+18P = 28 Hours**
CURRENT COMPUTER FORENSICS TOOLS:
Software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

PRACTICES:
- Study of Computer Forensics and different tools used for forensic investigation.
- Live Forensics Case Investigation using Autopsy.
- Collect Email Evidence in Victim PC.
- Extracting Browser Artifacts.
- View Last Activity of Your PC.
- Find Last Connected USB on your system (USB Forensics).
- Comparison of two Files for forensics investigation by Compare IT software.

SKILLS:
- Identify sources and methods of system intrusion.
- Create bitwise images of hard drives for forensic analysis.
- Collecting evidence from log files.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with PO's
1	Apply basic legal concepts related to digital forensics and evidence collection.	Apply	1	1,2,3
2	Analyze various digital forensics frameworks and its usage to solve crimes.	Analyse	1	1,2,3
3	Analyze artifacts like logs, packet captures, and registry.	Analyse	2	1,2,3
4	Design and develop various forensic applications using variety of tools to carryout forensic investigation.	Analyse	2	1, 2, 3
5	Demonstrate the ability to use forensic tools.	Create	2	1, 2, 5

TEXT BOOKS:
1. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations,2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

REFERENCE BOOK:
1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

https://www.electrosoft-inc.com/resources/digital-forensics

22CY903 - FUNDAMENTALS OF SECURITY

Hours per week:			
L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Computer Networks

COURSE DESCRIPTION AND OBJECTIVES:
This course covers the fundamental aspects of information security. It will look at the attacks, services, security process, security maintenance as well as various techniques used by hackers. Other topic covered includes operating system security, E-Commerce services and architecture used in E-Commerce applications.

MODULE-1

UNIT-1   **12L+8T+0P = 20 hours**
INTRODUCTION:
Information Security Basics: Defining Information Security, Brief History of Security, Security as a Process, Not Point Products, CIA in Information Security
Information Security Process: Introduction to Assessment, Conduct an Assessment, Importance of Policy, Types of Policy-Information Policy, Security Policy, Computer Use Policy, Internet Use Policy, Creating Appropriate Policy, develop a Policy, Implement Security, Conduct Awareness Training, Conduct Audits.

UNIT-2   **12L+8T+0P = 20 hours**
SECURITY ATTACKS, SERVICES:
Introduction: Security Attacks, Types of attacks -Access attacks, Modification Attacks, Denial of service Attack, Repudiation Attacks.
Information Security Services: Confidentiality, Integrity, Availability, Accountability.
Hacker Techniques: Introduction- Identify Hackers Motivation, Historical Hacking Techniques, Advanced techniques, Malicious Code, Methods of the Targeted Hacker, Untargeted Hacker.

MODULE-2

UNIT-1   **12L+8T+0P = 20 hours**
OPERATING SYSTEM SECURITY:
Introduction - Operating System Security, Unix Security Issues, Windows NT Security Issues, Windows 2000 Security Issues, System Access Threats-Intruders, Buffer Overflow, Access control, Operating System Hardening, Security maintenance.

UNIT-2   **12L+8T+0P = 20 hours**
E-COMMERCE SECURITY NEEDS
Introduction-E-Commerce Services, Understand the Importance of Availability, Implement Basic Security -Client-Side Security, Server–Side Security, Application Security, Database Security, Develop E-Commerce Architecture.

SKILLS:
➢ Develop security awareness program.
➢ Understand the information security aspects and find out the various security services to counter the attacks.
➢ Design and analyze of E-commerce model services.
➢ Study in consistence and vulnerabilities in computer systems.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

Cos No.	Course Outcomes	Blooms Level	Module No.	Mapping with PO's
1	Analyse the security aspects needed for information security	Analyse	1	1,2,3
2	Implement security attacks and various services provided to enhance the security system	Analyse	1	1,2,3
3	Analyze the operating systems security	Analyse	2	1,2,3
4	Analyze and develop e-commerce architecture by understanding e-commerce security needs	Analyse	2	1,2,3

TEXT BOOKS:
1. Eric Maiwald "Fundamentals of Network Security" McGraw Hill, 2010.
2. William Stallings, "Operating Systems Internals and Design Principles", Pearson education, Eighth Edition, 2018.

REFERENCE BOOKS:
1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu, J. David Irwin, CRC Press T&F Group.

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.haltdos.com%2Fblog%2Ffocusing-on-the-4-contemporary-security-fundamentals&psig=AOvVaw1zN2_tjPfXlcHf7L1mg_C5&ust=1664342058318000&source=images&cd=vfe&ved=0CAwQjRxqFwoTCNCO-92btPoCFQAAAAAdAAAAABAD

22CY904 - FUNDAMENTALS OF CRYPTOGRAPHY

PREREQUISITE KNOWLEDGE: Fundamentals of Security

COURSE DESCRIPTION AND OBJECTIVES:
This course focuses on offering the knowledge of applying cryptographic algorithms for providing confidentiality and integrity of the information. The objective of this course is to enable the student to understand and apply various security algorithms during data transmission and storage. By end of the course, students will be able to gain awareness on the need to protect data and resources from disclosure, to guarantee the authenticity of data and messages, and able to understand the strength of the cryptographic algorithms.

MODULE-1

UNIT-1   **12L+0T+8P = 20 hours**
INTRODUCTION AND SYMMETRIC CIPHERS:
Computer and Network Security Concepts: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, A Model for Network Security, Standards.
Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography.

UNIT-2   **12L+0T+8P = 20 hours**
BLOCK CIPHERS AND THE DATA ENCRYPTION STANDARD:
Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES, Block Cipher Design Principles, Multiple Encryption and Triple DES.
Advanced Encryption Standard and Block Cipher Operation: AES Structure, AES Transformation Functions, AES Key Expansion, An AES Example, AES Implementation
Block Cipher Operation: Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode.

PRACTICES:
- Implement Substitution and Transposition Ciphers
  - Ceaser cipher
  - Playfair cipher
  - Hill cipher
  - Rail fence cipher
- Implement Symmetric Cipher
  - S-DES
  - RC4

MODULE-2
UNIT-1   **12L+0T+8P = 20 hours**
STREAM CIPHERS AND ASYMMETRIC CIPHERS:
Stream Ciphers: Stream Ciphers, RC4 Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm

Other Public-Key Cryptosystems: Diffie–Hellman Key Exchange

UNIT-2   **12L+0T+8P = 20 hours**
CRYPTOGRAPHIC DATA INTEGRITY ALGORITHMS:
Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple
Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining,
Secure Hash Algorithm (SHA)

Message Authentication Codes: Message Authentication Requirements, Message
Authentication Functions, Requirements for Message Authentication Codes, Security of MACs,
MACs Based on Hash Functions: HMAC, Digital Signatures.

PRACTICES:
- Implement Asymmetric Cipher
    - RSA
    - Diffie-Hellman
    - Hash Function

SKILLS:
- Identify and resolve different types of security vulnerabilities.
- Differentiate classical encryption methods with modern encryption algorithms.
- Develop hashing and digital signature techniques.
- Compare and evaluate different encryption algorithms.

COURSE OUTCOMES:
Upon completion of the course, the student will be able to achieve the following outcomes:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with PO's
1	Apply various public key cryptography techniques.	Apply	1	1,2,3
2	Analyze various encryption techniques to provide confidentiality.	Analyze	1	1,2,3
3	Analyze & develop various encryption techniques to provide confidentiality.	Analyze	2	1,2,3
4	Implement symmetric & asymmetric ciphers and hashing techniques to provide integrity.	Create	2	1,2,3

TEXT BOOKS:
1. Cryptography and Network Security: Principles and Practice by William Stallings, 7th Edition, Person Publication.
2. William Stallings, "Network Security Essentials Applications and Standards", 2nd edition, Pearson Education, 2009.

REFERENCE BOOKS:
1. Eric Malwald, "Fundamentals of Network Security", 4th edition, Pearson education, 2010.
2. Charlie Kaufman, "Radis Perlman and Mike Speciner, Network Security – Private Communication in a Public World", 1st edition, Pearson Education, 2009.

3. Buchmann, "Introduction to Cryptography", 2nd edition, Pearson Education, Springer, 2009.
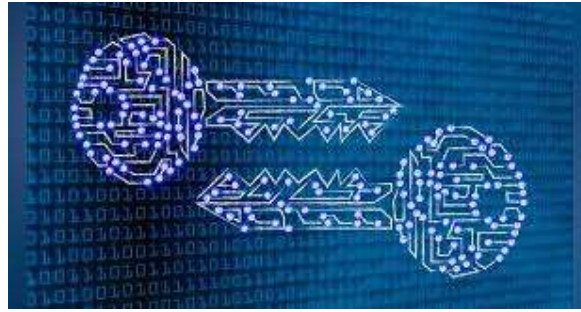
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ologies%2Fembedded-revolution%2Farticle%2F21128993%2Fmaxim-integrated-
cryptographic-fundamentals&psig=AOvVaw3QmN3Wdpq1R_glg5jV-
O8i&ust=1664342454307000&source=images&cd=vfe&ved=0CAwQjRxqFwoTCNCd5omdtP
oCFQAAAAdAAAAABAD

	Hours per week:		
L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Cryptography and Network Security

COURSE DESCRIPTION AND OBJECTIVES:

The objective of this course is to familiarize students with hacking techniques, methodologies, tools, tricks, and security measures to secure an organization's IT systems. Students undergoing this course are exposed to Ethical Hacking ethically penetrates into network systems using various tools to test the strength of a network and Get in-depth theoretical knowledge and rich practical experience in hacking test networks.

MODULE-1

UNIT-1   12L+0T+8P = 20 Hours

ETHICAL HACKING:

Introduction, Networking & Basics, Foot Printing, Google Hacking, Scanning, Windows Hacking, Linux Hacking, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering.

UNIT-2   12L+0T+8P = 20 Hours

INTRODUCTION TO COMPUTER SYSTEMS AND NETWORKS:

Information systems and networks (including wireless networks) and their role in industry business and society, System and Network Vulnerability and Threats to Security, various types of attack and the various types of attackers in the context of the vulnerabilities associated with computer and information systems and networks.

PRACTICES:

- Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup 196ogether information about networks and domain registrars.
- Understand the following methods and identify the tools used for.
    - Remote password guessing
    - Password sniffing
    - Privilege Escalation
    - Keystroke Loggers
- Use elsave.exe and Win Zapper to erase event logs.

MODULE-2

UNIT-1   12L+0T+8P = 20 Hours

PHYSICAL SECURITY:

Steganography, Cryptography, Wireless Hacking, Firewall & Honeypots, IDS & IPS, Vulnerability, Penetration Testing, Session Hijacking, Hacking Web Servers, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobile Phone Hacking.

UNIT-2 **12L+0T+8P = 20 Hours**
TOOLS:
An introduction to basic ethical hacking tools and usage of these tools in a professional environment in a form of project.
Ethical Responsibilities: An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking. Ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking.

PRACTICES:
- Detect ARP spoofing using open source tool ARPWATCH.
- Explore the Session Hijacking tools like Juggernaut, Hunt, TTY Watcher.
- Use the Nessus tool to scan the network for vulnerabilities.
- Install IDS (e.g. SNORT) and study the logs
- Use of iptables in linux to create firewalls.

SKILLS:
- Compare system and network vulnerabilities.
- Usage of hacking tools
- Explore SQL injection attack and Cross-site scripting attack

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with PO's
1	Apply physical security methods to find the attacks	Apply	2	3
2	Analyze various ethical hacking methods that are affecting the system	Analyze	1	1,2,3
3	Analyze vulnerabilities associated with computer and information systems and networks.	Analyze	1	1,2,3
4	Demonstration of the ethical hacking tools	Create	2	1,2,5

TEXT BOOKS:
1. Hands On Ethical Hacking and Network Defense – By Michael T. Simpson, Kent Backman, James Corley.
2. Official Certified Ethical Hacker Review Guide – By Steven DeFino, Barry Kaufman, NickValenteen.

REFERENCE BOOKS:
1. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy (Syngress Basics Series) [Paperback].
2. Hands On Ethical Hacking and Network Defense [Print Replica] [Kindle Edition].

https://www.besanttechnologies.com/ethical-hacking-tutorial

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Computer Network

COURSE DESCRIPTION AND OBJECTIVES:
This course focuses on monitoring the network for security breaches, identify vulnerabilities anddevelop security protocols to stop potential threats. The objective of this course is to provide Confidentiality, Integrity, and Availability of the information in a network. By end of the course, students will be able to understand various network security applications, IPSec, Firewall, IDS, Web security, Email security, and Malicious software etc.

MODULE-1
UNIT–1   **12L+0T+8P = 20 hours**
NETWORK SECURITY APPLICATIONS:
Kerberos – X.509 Authentication Service – Public Key Infrastructure – Pretty Good Privacy – S/MIME.

UNIT–2   **12L+0T+8P = 20 hours**
IP SECURITY:
IP Security Overview – IP Security architecture- Authentication Header – Encapsulating Security Payload – Combining Security associations – Key Management.

PRACTICES:
- ▪ a. Configure IP Address in a system in LAN (TCP/IP Configuration)
     b. Configure DNS to establish interconnection between systems
     c. Configuring Windows Firewall
     d. Adding users, setting permissions
     e. Configure Mail server
- ▪ Demonstrate the usage of Wireshark to identify abnormal activity in network communication.
- ▪ Demonstrate usage of NMAP (Zenmap) Tool in Network Scanning

MODULE-2
UNIT–1   **12L+0T+8P = 20 hours**
SECURITY:
Web Security: Secure Socket Layer and Transport Layer Security – Secure Electronic Transaction.
System Security: Intruders – Intrusion Detection – Password Management – Malicious Software- Firewalls–Trusted Systems.

UNIT–2   **12L+0T+8P = 20 hours**
ATTACK TECHNIQUES:
Attack Techniques: Network reconnaissance-Nmap and vulnerability audits open VAS; DNS based attacks, Phishing-DNSTwist;
Network based malware attacks: Remote access Trojan - Poison Ivy and Domain name generation algorithm based Botnets;
LAN attacks: ARP Cache poisoning- Ettercap/arpspoof, MAC flooding, Man in the middle

attacks, Port Stealing, DHCP attacks, VLAN hopping;
Network Sniffing: Wireshark and Password Cracking-John the Ripper;
Attacks on SSL/TLS: SSL stripping, Drown and Poodle attack;
Network packet creation and Manipulation using scapy and dpkt libraries.

PRACTICES:
- Demo of Eavesdropping attack and its Prevention using SSH.
- Demonstrate how to provide secure data storage, secure data transmission and for creating digital signatures (GnuPG)
- Setup a honey pot and monitor the honeypot on network (KF Sensor)
- Installation of rootkits and study about the variety of option.
- Perform wireless audit on an access point or a router and decrypt WEP and WPA. (NetStumbler)
- Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w

SKILLS:
- Test and resolve threats and malfunctions in network.
- Apply different security mechanisms for web applications.
- Build authentication systems for security protocol.

COURSE OUTCOMES:
Upon completion of the course, the student will be able to achieve the following outcomes:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with PO's
1	Apply various security protocols to safe guard the data internet using SSL/TCL.	Apply	1	2,3
2	Analyze protocols for network security to protect against various threats during e-commerce transactions.	Analyze	1	1,2,3
3	Analyze the usage of secure protocols to safeguard sensitive data using internet.	Analyze	2	1,2
4	Demonstrate various tools to identify abnormal activity in network communication and design appropriate action.	Analyze	2	1,5

TEXT BOOKS:

1. Cryptography and Network Security: Principles and Practice by William Stallings, 7th Edition, Person Publication
2. William Stallings, "Network Security Essentials Applications and Standards", 2nd Edition, Pearson Education, 2009

REFERENCE BOOKS:

1. Eric Malwald, "Fundamentals of Network Security", 4th edition, Pearson education, 2010.
2. Charlie Kaufman, "Radis Perlman and Mike Speciner, Network Security – Private Communication in a Public World", 1st edition, Pearson Education, 2009.

3. Buchmann, "Introduction to Cryptography", 2nd edition, Pearson Education, Springer, 2009.

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.logsign.com%2Fblog%2Fhow-to-ensure-network-security%2F&psig=AOvVaw1_kLfgmIH_9le8HziCfNap&ust=1664342786414000&source=images&cd=vfe&ved=0CAwQjRxqFwoTCMjF2p2etPoCFQAAAAAdAAAAABAD

MINOR ON DATA SCIENCE
Offered by Department of Computer Science and Engineering

In the recent years, there is an escalating demand for professionals having data science skill set in the industry. From marketing, finance and health care, to business, psychology and sociology, many industries are searching for employees having skills to manage large amounts of data. The inter disciplinary nature of this minor enables students to analyse large data sets in their disciplines.

The Data Science Minor is designed to strengthen the graduate's ability to apply statistical, mathematical, and computer science methods to traditional areas of empirical research within their fields. Students completing this minor will gain significant experience working with data analysis, including the theory and practical skills needed to collect and prepare data for analysis, explore and visualize data, build models and test hypotheses, discover insights, and communicate results in meaningful ways. The target audience for this minor are students who are interested in learning from data but may have little or no data analysis background. This minor is intended to complement undergraduate degree programs and provide students with the necessary mathematical, statistical and machine learning background to develop and apply various data analysis techniques to real world datasets. This data scince minor comprises of 5 courses or 20 credits in length and is open to all the BTech under graduate students and upon completion, the students will be able to:

- Formulate questions in a domain that can be answered with data.
- Use tools and algorithms from statistics, applied mathematics, and computer science for analyses.
- Visualize, interpret, and explain results cogently, accurately, and persuasively.
- Understand the underlying social, political, and ethical contexts that are importantly and inevitably tied to data-driven decision-making.

Course Code	Course Title	L	T	P	C
22DS901	Big Data Analytics	3	0	2	4
22DS902	Data Science using Python	2	2	2	4
22DS903	Introduction to Python Programming	2	2	2	4
22DS904	Statistical Methods and Data Visualization	3	0	2	4
22DS905	Machine Learning	3	0	2	4
22CS909	Capstone Project	0	2	6	4

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of Databases, Data mining.

COURSE DESCRIPTION AND OBJECTIVES:
This course serves as an introductory course to gain knowledge on analysing Big Data. Expecting to face Big Data storage, processing, analysis, visualization, and application issues on both workplaces and research environments. Get insight on what tools, algorithms, and platforms to use on which types of real world use cases.

MODULE-1

UNIT-1   **12L+0T+8P=20 Hours**
INTRODUCTION TO BIG DATA:
Data, Characteristics of data and Types of digital data, Sources of data, Working with unstructured data, Evolution and Definition of big data, Characteristics and Need of big data, Challenges of big data.

Big Data Analytics: Overview of business intelligence, Data science and Analytics, Meaning and Characteristics of big data analytics, Need of big data analytics, Classification of analytics, Challenges to big data analytics, Importance of big data analytics, Basic terminologies in big data environment.

UNIT-2   **12L+0T+8P=20 Hours**
INTRODUCTION TO HADOOP:
Introducing Hadoop, need of Hadoop, limitations of RDBMS, RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop, Hadoop Overview, Use Case of Hadoop, Hadoop Distributors, HDFS (Hadoop Distributed File System), Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator), Interacting with Hadoop Ecosystem.

PRACTICES:
- Hadoop installation in standalone machine.
- Pig installation.
- Setup of Hadoop cluster.
- HDFS basic command-line file operations.
- HDFS monitoring User Interface.

MODULE-2

UNIT-1   **12L+0T+8P=20 Hours**
MAPREDUCE PROGRAMMING:
Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression, Real time applications using Map Reduce, combiner, Partitioner, matrix multiplication using Map Reduce and page rank algorithm using Map Reduce.

UNIT-2   **12L+0T+8P=20 Hours**

PIG:

Introduction to Pig, The Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use Case for Pig: ETL Processing, Pig Latin Overview, Data Types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Piggy Bank, Word Count Example using Pig, Pig at Yahoo!.

Hive: Introduction to Hive, Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), Partitions and bucketing, working with XML files, User-Defined Function (UDF) in Hive, Pig versus Hive.

Spark Programming: Introduction, features of Spark, components of Spark, Programming with Resilient Distributed datasets (RDDS).

PRACTICES:

- Word Count Map Reduce program using Hadoop.
- Implementation of word count with combiner Map Reduce program.
- Practice on Map Reduce Monitoring User Interface.
- Implementation of Sort operation using Map Reduce.
- Map Reduce program to count the occurrence of similar words in a file by using partitioner.
- Design Map Reduce solution to find the years whose average sales is greater than 30.
  - o input file format has year, sales of all months and average sales.
  - o Year Jan Feb Mar April May Jun July Aug Sep Oct Nov Dec Average.
- Map Reduce program to find Dept wise salary.
  - o Empno Emp Name Dept Salary.
- Designing of Pig Latin scripts to sort, group, join, project and filter the data.
- Implementation of Word count using Pig.
- Creation of Database and tables using Hive query language.
- Implementation of partitions and buckets using Hive query language.
- Implementation of word count using spark RDD.

SKILLS:

➢ Build and maintain reliable, scalable, distributed systems with Apache Hadoop
➢ Develop Map Reduce based applications for Big data
➢ Design and build applications using Hive and pig based Big data applications
➢ Learn tips and tricks for big data use cases and solutions

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Use of Big data frameworks like Hadoop and NOSQL to efficiently store and process Big data to generate analytics.	Apply	1	1, 2, 5,9,10,12
2	Apply a solution for data intensive problems using Map Reduce paradigm.	Apply	1	1, 2, 5, 9,10,12
3	Apply and analyze the solutions of Big data using Pig and Hive to solve data intensive and to generate analytics.	Analyze	2	1, 2, 3, 5, 9,10,12

4	Analyze Big data using Spark programming	Analyze	2	1, 2, 3, 5, 9,10,12

TEXT BOOKS:
1. Seema Acharya, Subhashini Chellappan, "Big Data Analytics", Wiley, 2015.
2. Holden Karau, Andy Konwinski, Patrick Wendell, MateiZaharia, "Learning Spark: Lightning-Fast Data Analysis", O'Reilly Media, Inc., 2015.

REFERENCE BOOKS:
1. Boris Lublinsky, KevinT. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, 2015.
2. Chris Eaton, Dirk deRooset al. , "Understanding Big data ", McGraw Hill, 2012.
3. Tom White, "HADOOP: The definitive Guide", O Reilly 2012.

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22DS902–DATA SCIENCE USING PYTHON

Hours per week:

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Python programming

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces the basic concepts of data science. This course makes students familiar with python libraries to handle various datasets and the methods for cleaning, transforming and enrichment of data. In addition, this course enables the students to train the applications of data science and perform data transformations.

MODULE-1

UNIT-1   **8L + 8T + 8P = 24 Hours**

INTRODUCTION TO DATA SCIENCE:

Steps in doing Data Science - Data Science relation to other fields- Data Science and Information Science- Computational Thinking - Skills and tools needed to do Data Science - Storing data - Combining bytes into larger structures - Creating data sets - Identifying data problem - Understanding data sources - Exploring data models- Introduction to Big Data

UNIT-2   **8L + 8T + 8P = 24 Hours**

DATA ACQUISITION:

Import data into Pandas from various data sources: Fetching stored data- CSV, Excel, Pdf, text, multiple text files, RDBMS (SQL Tables), pickle and JSON; importing data from clipboards, working with binary data formats, Web scraping-beautiful soup for reading and parsing of web pages, reading data from XML, reading data from an API, Reading Image files using PIL, read multiple files using Glob

PRACTICES:

- ▪ **Write code to perform the following operations:**
  - o Load the data stored in different files formats: CSV, Excel, txt, ZIP, database, JSON, pickle
  - o Saving data into different files formats: CSV, Excel, txt, ZIP, database, JSON, pickle
  - o Web Scraping- Use requests module to retrieve data from any website of your interest, improve readability of the extracted data using Beautiful Soup library
  - o Reading Image Folders: retrieve images stored in our local folders and visualize few samples from each class
  - o Merge multiple data frames, split a data frame into multiple data frames, apply different joins on two data frames

o Data pre-processing- formatting data to standardize it and make it consistent, normalizing data, grouping data values into bins

<p align="center">MODULE-2</p>

UNIT-1   **8L + 8T + 8P = 24 Hours**
DATA CLEANING:
Sub-Setting, Filtering, And Grouping: Sub-setting the Data Frame, the unique Function, Conditional Selection and Boolean Filtering, Setting and Resetting the Index, The Group By Method, Aggregating.
Detecting Outliers and Handling Missing Values: Outlier detection, Missing Values in Pandas, Filling and dropping missing Values in Pandas, Outlier Detection and removing duplicates.

UNIT-2   **8L + 8T + 8P = 24 Hours**
DATA ENRICHMENT:
Data Integration and transformation: Combining, merging, and joining data sets, string and text processing using regular expressions, Transforming Numerical features – power transformation, binning, binarization, data transformation based on mappings, Encoding Categorical data- One-hot encoding, Ordinal encoding, Label encoding of the target variable; Scaling- Normalization, Standardization, Robust scaling

Learning The Hidden Secrets: Advanced list comprehension and zip function, Date and time data types and tools, Time series basics, Time zone handling

PRACTICES:
- **Apply the following operations on the given csv file**
  o Load data from CSV files
  o Retrieve first 10, last 10 rows, 3rd Column and a subgroup
  o Query and index operations on the above data frame
  o Insert, delete and update your data
  o Apply aggregate operations
  o Apply various filters on the data
  o Group, merge, and aggregate data in the data frames
- **Apply the following operations on the given csv file**
  o Load the csv and convert to data Frame
  o Identify the total number of missing values
  o Replace the missing values with a constant, with the Mean of that column, with the mode of that column
  o Remove missing values on the original csv file
  o Apply fill options and replace
- Load a CSV file, change column names, apply required transformations on the data
- Load a CSV file, apply binning to transform numeric data to categorical data
- Load a CSV file, encode the categorical values- transforms non-numerical labels into numerical labels, One-Hot encoding, and Binary encoding
- Merge multiple data frames, split a data frame into multiple data frames, apply different joins on two data frames

- Data pre-processing- formatting data to standardize it and make it consistent, normalizing data, grouping data values into bins
- Work With Datetime Format in Python - Time Series Data, Convert integer to DateTime, Extract DateTime into Different Columns, Assemble DateTime from Different Columns
- Create Pandas DateTime Series using date_range() method
- **Load data that contains dates and times**
  - Convert strings to datetime
  - Assemble a datetime from multiple columns
  - Get year, month and day
  - Get the week of year, the day of week, and leap year
  - Get the age from the date of birth
  - Improve performance by setting date column as the index
  - Select data with a specific year and perform aggregation
  - Select data with a specific month and a specific day of the month
  - Select data between two dates
  - Handle missing values

SKILLS:

- Data Handling
- Data Enriching
- Data analysis Tool usage

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply data acquisition tools to collect and visualize	Apply	1	1
2	Tool usage for data acquisition and engineering	Apply	1,2	1,5
3	Analyzethe data and apply suitable pre-processing and transformation techniques	Analyze	1,2	2
4	Create standard datasets for data science projects	Create	1,2	3

TEXT BOOKS:
1. Jeffrey S. Saltz, Jeffrey M. Stanton, "An Introduction to Data Science", SAGE Publications, 2018.
2. Wes McKinney, "Python for data analysis", 1st Edition, O'Reilly Media, 2012.

REFERENCE BOOKS:
1. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython by Wes McKinney, 2017.
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020.

Image source:https://www.fivesquid.com/pics/t2/1622388942-172793-1-1.jpg
Image file name: Data Analysis using Python libraries

22DS903-INTRODUCTION TO PYTHON PROGRAMMING

Hours per week:

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Prior knowledge of any programming language and

object-oriented concepts is helpful but not mandatory.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers sufficient knowledge required to understand the fundamental concepts of Python programming language. This course enables students to choose appropriate data structures (lists, dictionaries, tuples, sets, strings) for the given problem. In addition, the students will be able to create reliable, modular and reusable applications using Object- Oriented Programming approaches. At the end they will get an idea of how to access database using python programming, develop web applications, and using web Services using python
Programming.

MODULE-1

UNIT-1   **6L+6T+6P=18 Hours**
INTRODUCTION:

Introduction to python, Variables, Assignment, Keywords, Built-in functions, Indentation, Comments, Basic data types - integers, float, complex, Boolean, strings; Python program development, running python using REPL shell, Python scripts.

Operators and Expressions: Operators- arithmetic operators, comparison (relational) operators, assignment operators, logical operators, bitwise operators, membership operators, identity operators; Expressions and order of evaluations.

Control Structures: Conditional control structures - if, elif, else; Loop control structures - for, while, for... else, while…else, nested loops, break, continue, pass.

UNIT-2   **10L+10T+10P=30 Hours**

PYTHON DATA STRUCTURES AND FUNCTIONS:

Data Structures: Lists, Tuples, Sets, Strings, Dictionary - creation, accessing, basic operators and methods; List comprehensions.

Functions: Defining functions, calling functions, Passing arguments - keyword arguments, default arguments, positional arguments, variable-length arguments; Types of functions-anonymous functions, fruitful function, recursive functions; Scope of the variables- global and local variables, Development of recursive and non-recursive functions.

PRACTICES:
- ▪ A. Given an integer N, write a program to find its 1's complement.

B. Given two integers N1 and N2, write a program to find their product without using multiplication ('*') operator and loops.

C. Given two integers N1 and N2 having same value, write a program to check whether N1 and N2 points to the same object or not.

- A. Given an Integer N, write a program to check whether given number is even or odd without using modulus operator.

  D. Given a number N, number of bits K and starting position P, write a program to extract K bits from a position P (from right) in the binary representation of N. Convert the extracted bits in decimal number.

- Given coordinates of centre of a circle, radius and a point coordinate, write a program to check whether the given point lies inside or on the circle, or outside the circle.

- Write a program to find the sum of digits in a given integer.

- Given an integer N as an input, decides the geometrical figure for which the area has to be calculated, for example N=1 for circle, N=2 for rectangle, and N=3 for triangle. Write a program to display the area of the respective figure.

- A semi prime number is an integer which can be expressed as a product of two distinct primes. For example, 15 = 3*5 is a semi prime number but 9 = 3*3 is not. For a Given an integer number **N**, write a program to find whether it can be expressed as a sum of two semi-primes or not (not necessarily distinct).

- Given an integer amount X, write a program to find the minimum number of currency notes $ (500, 100, 50, 20, 10, 5, 2, 1) required for the given amount.
  Input:
    575
  Where input is the amount for which we have to calculate the number of currency notes.
  Output: 4
  Explanation: Total amount = 1(500 dollar note) + 1(50 dollar note) + 1(20 dollar note) + 1(5 dollar note) = 575, hence the minimum number of notes required is 4.

- For a given a string S and width W, write a program to wrap the string S into a paragraph of width W.

  Example:

  Input:

  ABCDEFGHIJKLIMNOQRSTUVWXYZ

  4

  Output:

ABCD   EFGH   IJKL   IMNO   QRST   UVWX
YZ

- Write a program to Measure the required time to access the first element, nth element and n/2 element stored in list and tuple data structure.

- Given a list L of **N** numbers (integers), Write a program to find the sum of the elements of given list **L** with the corresponding elements of the reverse of list L. If list L has elements **[1,2,3]**, then reverse of the list L will be **[3,2,1]** and the resultant list should be **[4,4,4]**.

- Given a positive integer number **n**. Write a program to generates a dictionary **d** which contains **(i, i*i*i)** such that **i** is the key and **i*i*i** is its value, where **i** is from **1 to n (both included)**. Print the content of the dictionary **d**.

- Write a program to create a data structure to store student information such as regd no, name, percentage of marks, phone number and display the student details based on the order of percentage of marks.

- For a Given a string, design and implement functions to perform the following:
  a) remove vowels in the given string.
  b) count number of uppercase and lowercase letters.
  c) remove all special characters.
  d) check whether it is a palindrome or not.
  e) swap case of each letter.

- Create a function that receives 3 numbers and returns the median, i.e. the number that is not the min and not the max, but the one in between.

- Given two lists of integer numbers, write a function to perform the following operations.
  a. print elements that are common in both the lists. (Print without duplicates).
  b. print elements that are present in the first list and not present in second list.
  c. print elements that contain the first element of the first list and last element of the second list.
  d. print elements that contain sum of elements of first list and sum of elements of second list.
  e. print largest number of both the lists.
  f. print smallest number of both the lists.

MODULE-2

UNIT-1   **8L+8T+8P=24 Hours**
MODULES:
Creating modules, Import Statement, From...Import Statement, Name Spacing, Creating user defined modules
Standard Modules: sys, math, date, time, os, random and itertools modules.
Packages: Numpy, Pandas, Matplotlib, Requests, Nltk.
File Processing: Reading and writing files -creating a new file, writing to a file, reading text files, opening and closing files, reading, writing, tell (), seek (), rename ().

UNIT-2   **8L+8T+8P=24 Hours**
ERRORS AND EXCEPTIONS:
Introduction to Exceptions, Handling Exception, Try Except Else and Finally Block, Raising Exceptions.
Simple Graphics and Image Processing: Overview of Turtle Graphics, Two Dimensional Shapes, Colours and RBG System and Image Processing

PRACTICES:
- Given a string 'S', find all possible permutations of the string S in lexicographic sorted order. Each Permutation size is "2" or "3".
  Sample Input:
  HACK
  Expected Output: AC AH AK CA CH CK HA HC HK KA KC KH

- Write a program that finds area of the pentagon when length from center of a pentagon to vertex are given, the formula for computing the area of pentagon is $\frac{3\sqrt{3}}{2}$ s^2, where s is the length of the side, the side can be computed using formula s= 2r sin$\frac{\pi}{5}$, where r is the length from the center of a pentagon to vertex.

- Given X as a date. Write a program to find what the day is on that date.
  Sample Input: 08 05 2015
  Expected Output: Wednesday

- Arun is working in an office which is **N** blocks away from his house. He wants to minimize the time it takes him to go from his house to the office. He can either take the office cab or he can walk to the office. Arun's velocity is **V1 m/s** when he is walking. The cab moves with velocity **V2 m/s** but whenever he calls for the cab, it always starts from the office, covers **N** blocks, collects Arun and goes back to the office. The cab crosses a total distance of **N** meters when going from office to Arun's house and vice versa, whereas Arun covers a distance of (2–√∗N)(2∗N) while walking. Help Arun to find whether he should walk or take a cab to minimize the time.
  Input Format:
  A single line containing three integer numbers N, V1, and V2 separated by a space.
  Example-1:
  Input:
  5 10 15

Output:
Cab

- Create a binary NumPy array (containing only 0s and 1s) and convert a binary NumPy array in to to a Boolean NumPy array

- Convert the first column of a Data Frame as a Series by using suitable packages.
  Sample Input:
  Original Data Frame
  ```
        col1 col2  col3
    0    1    4    7
    1    2    5    5
    2    3    6    8
    3    4    9    12
    4    7    5    1
    5    11   0    11
  ```

  Sample Output:
  ```
  0    1
  1    2
  2    3
  3    4
  4    7
  7    11
  ```

- Create two text files and read data from two text files. Display a line from first file followed by the corresponding line from the second file.

- Define the following functions that are more robust to erroneous input data
  a) To divide two numbers (To handle Zero Division Error).
  b) To read two integer numbers and display them (To handle Value Error).
  c) To display elements of a list (To handle Index Error).
  d) To open a file and display file contents (To handle File Not Found Error)

- Write a python program to handle multiple exceptions using raise keyword.
- Draw the spiral hexagon, where we use turtle to create a spiral structure. The final shape is a hexagon and there are various colors used in producing the sides of the hexagon.

- Implement a program to print it in a counterclockwise spiral form for a given square matrix.

- **Sample Input:**
  ```
      4
      25 1 29 7
      24 20 4 32
      16 38 29 1
  ```

48 25 21 19
Sample Output:
25 24 16 48 25 21 19 1 32 7 29 1 20 38 29 4

- ▪ Write a function that finds the nearest prime number of a given number.

SKILLS:

- ➢ Installation and usage of python libraries.
- ➢ Working with varieties of data structures.
- ➢ Improved analytical and problem-solving abilities.
- ➢ Developing structured modular and Object-oriented programming solutions.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Make use of different data types to design programs involving decisions, loops, and functions.	Apply	1	1, 2, 5
2	Develop functional, reliable and User-friendly Python programs for given problem statement and constraints.	Apply	2	1, 2, 3,5
3	Installing the python environment and related packages that are required for practical and contemporary applications.	Apply	2	1, 2,3,5
4	Analyze the usage of different data structures for practical and contemporary applications for a given problem.	Analyze	1	1, 2, 3, 5
5	Analyze various features of programming language and their application in problem solving in computer programming to write, compile, and debug programs in python language.	Analyze	1	1, 2

TEXT BOOKS:

1. Kenneth A. Lambert, "The Fundamentals of Python: First Programs", Cengage Learning, 2011.
2. Mark Lutz, "Learning Python", 5th edition, Orielly Publishers, 2013.

REFERENCE BOOKS:

1. Introduction to Computation and Programming Using Python. John V. Guttag, The MIT Press.
2. James Payne, "Beginning Python using Python 2.6 and Python 3", Wrox publishing.
3. Paul Gries, "Practical Programming: An Introduction to Computer Science using Python 3", The Pragmatic Bookshelf, 2nd edition, 4 Oct. 2013.
4. Allen B. Downey, "Think Python", 1st edition, Orielly publishing.

https://www.hitalent.co/blog/2019/12/tech-jobs-python-programming-language-and-aws-skills-demand-has-exploded

22DS904 - STATISTICAL METHODS AND DATA VISUALIZATION

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Python programming

COURSE DESCRIPTION AND OBJECTIVES:
Statistics is critical for machine learning and this course imparts sufficient statistical knowledge required for machine learning. Statistics allow us to gather insights from data and determine whether our assumptions are valid or not. Using statistics, we can make educated assumptions and forecasts based on real-world data. This course makes students familiar with python libraries to apply statistical analysis and covers advanced python data structures and visualization methods. In addition, it teaches how to use python to implement advanced statistical analysis.

MODULE-1

UNIT-1   **14L+0T+12P=26Hours**
Python for Statistics: Why Statistics? Python Packages for Statistics, Numpy and Pandas data structures for statistics; Data Input: Load data from CSV, Excel, ASCII and Text Files; Saving data into files; Data types: Categorical and Numerical.

Data Visualization: Elements of data visualization, Exploration plots: Scatter plots, Line plots, bar plots, box plots, Error-plots, histograms, Kernel-density-estimation plots, Cumulative frequencies, Error-bars, box-plots, bubble-plot, grouped bar charts, pie charts, Advanced plots: correlation, regression, waffle charts, word clouds, Bi-variate, and multivariate plots.

UNIT-2   **10L+0T+4P=14Hours**
DESCRIPTIVE STATISTICAL ANALYSIS
Populations And Samples: Population Vs Sample, Need for Sampling,
Sampling Techniques: Random Sampling, Clusters Sampling, Systematic Sampling, Stratified Sampling Techniques.
Descriptive Statistical Analysis: Measures of Central Tendency: Mean, Median, Mode, Geometric Mean; Measures of Dispersion: Range, Percentiles, Standard Deviation and Variance.

PRACTICES:
- **Write code to perform the following operations on Numpy arrays:**
  i.   Create a 2D Numpy array with 24 elements of size 4x6 and retrieve the last three rows, retrieve the first two column values, retrieve the sum of the second row, retrieve the sum of first column, and display the max value index in the array
  ii. Create a 2D Numpy array with 42 elements of size 7x6, add a new row, Delete an existing column, replace a specific value, and identify how many values are less than given x

iii. Create a 1D-array with 64 elements, Reshape the array into 4, 2x8 arrays, also reshape the array into other possible shapes, Convert the data type into float, Split the array into three sub-arrays of same size

iv. Create a 2D Numpy array with 35 elements of size 7x5, identify unique values in the array, identify the existence of duplicates, perform conditional replace operations, insert NaNs, replace NaNs,

- **Load a CSV file into Numpy array and apply the following:**
    i. Write the code routine to print the masked (gray) colored sub-array
    ii. Print the maximum of the fifth row.
    iii. Reshape the array (change columns to rows, rows to columns)
    iv. Extract all the odd number using conditional logic
    v. Find the column wise mean, std and variance

- **Pandas library for analyzing tabular data:**
    o Load data from CSV files and understand your data
    o Query and index operations on the above data frame
    o Insert, delete and update your data
    o Apply various filters on the data
    o Group, merge and aggregate data in the data frames
    o Identify and Fix missing values in the data

- **Apply the following operations on the given csv file**
    i. Load data from CSV files
    ii. Retrieve first 10, last 10 rows, 3rd Column and a subgroup
    iii. Query and index operations on the above data frame
    iv. Insert, delete and update your data
    v. Apply aggregate operations
    vi. Apply various filters on the data
    vii. Group, merge, and aggregate data in the data frames

- **Visualize data with the help of the following graphical representations:**
    (a) Line plots (b) Bar plots (c) Error Plots (d) Scatter plots (e) KDE Plots (f) Heat Maps (g) Box Plots (h) Pie graph (i) Histogram (j) multiple graphs in single figure (k) saving figures

MODULE-2
UNIT-1   **12L + 0T + 8P = 20 Hours**
PROBABILITY DISTRIBUTIONS
Discrete Distributions: Bernoulli Distribution, Binomial Distribution, Poisson Distribution.

Continuous Distributions: Normal Distribution and Examples of Normal Distribution; Central Limit Theorem

Continuous Distributions Derived from The Normal Distribution: t-Distribution, Chi-Square Distribution, F-Distribution.

UNIT-2   **12L + 0T + 8P = 20 Hours**
HYPOTHESIS TESTS FOR STATISTICAL ANALYSIS
Typical analysis Procedure: Data Screening and Outliers, Normality Check; Hypothesis
Concept, Errors, p-Value, Interpretation of the p-Value, Types of Error, Sensitivity and
Specificity

Hypothesis Tests For Statistical Analysis: z-test, Student's t-Test, One-Way Chi-Square Test,
Chi-Square Contingency Test, Analysis of Variance (ANOVA): One-Way ANOVA, Two-Way
ANOVA.

Linear Regression Models: Linear Correlation-Correlation Coefficient, Rank Correlation;
General Linear Regression Model, Coefficient of Determination, Linear Regression Analysis
with Python

PRACTICES:

- **Sampling and Resampling:**
    - Generate a population of random numbers
    - Generate multiple samples using Random sampling with and without random
      sampling
    - Load a balanced dataset and visualize the class distribution
    - Load an imbalanced dataset and visualize the class distribution
- **Interpreting Data Using Descriptive Statistics:** Compute Mean, Median, Mode, Standard
  Deviation, Variance, Co-variance, Interquartile Range and Skewness for two different
  datasets and write your interpretations about these statistical measures. Which measure is
  best suitable? Justify
- **Generating Samples from Probability Distributions:**
    - Generate a set of random numbers (which corresponds to a uniform distribution)
      using the function rand and plot its histogram. What is the shape of this histogram
      and why?
    - Investigate how the shape of the histogram is affected by the number of random
      numbers you have generated.
    - Similarly generate numbers using Bernoulli, Binomial distributions and plot a histo
      gram and check the shape.
    - Generate numbers using exponential and poisson distributions and plot a histo gram
      and check the shape.
- **Hypothesis tests:** Implement the following three popular statistical techniques for
  hypothesis testing:
    - Chi-square test, T-test and ANOVA test (Calculate the Test Statistic and P-value by
      running a Hypothesis test that well suits your data and Make Conclusions).
- **Linear Regression Analysis:** Download house prediction dataset and explore the data,
  Prepare the dataset for training, Train a linear regression model, and Make predictions and
  evaluate the model.

SKILLS:
- ➢ Statistical Tool Usage
- ➢ Data analysis
- ➢ Visualization

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply data acquisition tools to collect and visualize	Apply	1	1
2	Installation and Usage of Python Tools for data visualization and statistical analysis	Apply	1,2	1,5
3	Analyze data by evaluating various statistical measure	Analyze	1,2	2
4	Create statistical models for data analysis	Create	1,2	3

TEXT BOOK:
1. Thomas Haslwanter, "An Introduction to Statistics with Python With Applications in the Life Sciences, - Springer- ISSN 1431-8784 - ISBN 978-3-319-28315-9 Springer International Publishing Switzerland 2016.

REFERENCE BOOKS:
1. Zed A. Shaw, "Learn Python 3 the Hard Way", 1st edition, Pearson Education Inc 2018.
2. Peter Bruce, Andrew Bruce, Peter Gedeck, "Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python" 2nd edition, Oreilly Publishers, 2020.
3. Bharti Motwani, "Data Analytics using Python", 1st edition, Wiley Publisheres, 2021

Image source: https://www.bestproxyreviews.com/wp-content/uploads/2020/09/Statistical-Analysis-Methods.jpg

Image file name: Statistical data Analysis

22DS905–MACHINE LEARNING

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Probability & Linear Algebra, Python language.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides a broad introduction to various machine learning concepts including Supervised learning (parametric/non-parametric algorithms, support vector machines, kernels, neural networks) and Unsupervised learning (clustering, dimensionality reduction) methods. Students will get an understanding of various challenges of Machine Learning and will be able to decide on model complexity. Numerous case studies introduced in this course allow the students to apply machine-learning algorithms in computer vision, medical imaging, audio, and text domains. Laboratory experiments of this course will introduce students to advanced Machine Learning Python libraries such as Scikit-Learn, Matplotlib, and many other recent ML-related APIs. The course is designed such that the students get enough hands-on experience with a major focus onthe practical implementation of theoretical concepts.

MODULE-1

UNIT-1 **14L+0T+8P=22 Hours**

INTRODUCTION

What is machine learning? Machine learning applications; Types of Learning: Supervised learning; Un-supervised learning; Reinforcement learning.

Model Training Essentials: Re-sampling methods: Bias–Variance Trade-off. Hypothesis Testing and Variable Selection, Sub sampling and Up sampling, SMOTE; Cross Validation (validation set, Leave-One-Cut (LOO), k-fold strategies) and bootstrap; Evaluation measures - Error functions, Confusion Matrix, Accuracy, Precision and Recall, F1 Score.

Regression Analysis: Linear Regression, Simple and Multiple Linear Regression, Polynomial Regression, Logistic Regression, Multi nominal Regression. Ordinary Least Squares Method, Model Shrinkage-Ridge, and LASSO regression.

UNIT-2 **10L+0T+8P=18 Hours**

FEATURE SELECTION

Feature Selection Strategies: Problem statement and Uses, Filter methods, Wrapper methods, Embedded methods. Branch and bound algorithm, Sequential forward/backward selection algorithms.

Dimensionality Reduction: Singular value decomposition, matrix factorization, Linear discriminant analysis, Principal components analysis.

PRACTICES:
- Apply the following tasks to any given dataset:
    a. Load and visualize data
    b. Check out and replace missing values

c. Encode the Categorical data
d. Splitting the dataset into Training and Test set
e. Splitting the dataset into k-folds
f. Feature scaling
- House price prediction:
  a. Create a model that predicts a continuous value (price) from input features square footage, number of bedrooms and bathrooms.).
  b. Implement a univariate Model using Least Squares and plot best-fit line
  c. Implement a multivariate Model using Least Squares and plot best-fit line
  d. Retrieve model error and model coefficients
  e. Observe Variance Inflation Factor(VIF)
  f. Implement Ridge regression model
  g. Implement LASSO regression model
  h. Report your observations on the above models for house prediction
- Heart disease prediction:
  a. Implement a logistic regression model to predict whether an individual is suffering fromheart disease or not
  b. Evaluate and compare model performance using the following validation approaches:
      i. Validation set approach
      ii. K-fold cross validation
      iii. Stratified K-fold cross validation
      iv. LOO strategy
  c. Plot Confusion matrix
  d. Report performance of the model in terms of the following metrics:
      i. Accuracy
      ii.Precision-Recall
      iii. F1 Score
  e. Report your observations and explain when to use what type of measures
- Implement the Polynomial Regression algorithm to fit data points. Select the appropriate data set for your experiment and draw graphs.
- Working with imbalanced datasets:
  a. Load an imbalanced dataset and visualize imbalance in the data as a bar plot
  b. Implement KNN model for classification
  c. Balance the dataset using:
      i. Random Over sampling
      ii. Random Under sampling
      iii. SMOTE
  d. Implement KNN model for classifying data balanced in the above steps
  e. Report your observations on the performance of models trained using balanced and imbalanced data
- Perform effective feature selection in a given dataset using any one of the feature selection techniques.
- Dimension Reduction:
  c. Load a dataset and Implement Bayes classification model
  d. Apply dimension reduction using:
      i.Principal Component Analysis
      ii.Linear Discriminant Analysis
  c. Apply the model on data with reduced dimension

d. Compare and contrast model performance in each case

MODULE-2

UNIT-1   **16L+0T+8P=24 Hours**

CLASSIFICATION

Classification: Binary, Multi-class and Multi - label Classification; K-Nearest Neighbours, Support Vector Machines, Decision Trees, The Naïve Bayes' Classifier, Class Imbalance, Perceptron ANN model.

Ensemble Methods: Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking.

UNIT-2   **8L+0T+8P=16 Hours**

CLUSTERING
Clustering: Different distance functions and similarity measures, K-means clustering, Medoids, Hierarchical Clustering-Single linkage and Complete linkage clustering, Graph based Clustering -MST, DBSCAN, Spectral clustering.

PRACTICES:
▪ Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
▪ Implement the naïve Bayesian classifier for a sample training data set stored as a.csv file. Compute the accuracy of the classifier, considering few test data sets.
▪ Assuming a set of spam or not-spam mails that need to be classified, use the naïve Bayesian classifier model to perform this task. Calculate the accuracy, precision, and recall for your data set.
▪ Implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.
▪ Demonstrate the working of the decision tree-based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample?
▪ Build a model using SVM with different kernels.
▪ Implement and build models using the following Ensemble techniques
    a. Bagging
    b. Boosting: A daboost, Stacking
▪ Build a model to perform Clustering using K-means after applying PCA and determining the value of K using the Elbow method.
▪ Unsupervised Modeling:
    a. Cluster the data using the following models:
        i. Spectral Clustering
        ii. K-medoids
        iii. DBSCAN
        iv. Hierarchical Clustering
    b. Compare and contrast model performance in each case

SKILLS:

- ➤ Statistical data analysis.
- ➤ Classify / Cluster data.
- ➤ Tool usage for developing ML applications.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply a wide variety of learning algorithms such as Probabilistic, Discriminative and Generative algorithms for a given application.	Apply	1, 2	1
2	Analyze and evaluate the performance of various machine learning models approaches on different kinds of data.	Analyze	2	2
3	Create an end-to-end Machine-learning model to realize solutions for real-world problems.	Create	1	3
4	Implement various machine learning models using advanced ML tools.	Create	1, 2	5

TEXT BOOKS:

1. EthemAlpaydin, "Introduction to Machine Learning", 3rd edition, The MIT Press, 2014
2. Flach, Peter. "Machine learning: the art and science of algorithms that make sense of data". Cambridge University Press, 2012.

REFERENCE BOOKS:

1. Murphy, Kevin P. Machine learning: a probabilistic perspective. MIT press, 2012.
2. AurélienGéron, "Hands-on Machine Learning with Scikit Learn and Tensor Flow", O'reilly, 2017.
3. Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, "An Introduction to Statistical Learning with Applications in R", Springer, 2013. (ISLR).

https://www.forbes.com/sites/kalevleetaru/2019/01/15/why-machine-learning-needs-semantics-not-just-statistics/

MINOR ON EMBEDDED SYSTEMS AND INTERNET OF THINGS

Offered by Department of Electronics and Communications Engineering

Internet of Things (IoT) is a new paradigm that has changed the traditional way of living into a high-tech life style. Smart city, smart homes, pollution control, energy saving, smart transportation, smart industries are such transformations due to IoT. A lot of crucial research studies and investigations have been done in order to enhance the technology through IoT. The uniqueness of the Minors program is task-specific, where the students learn methodologies and practical knowledge regarding developing, integrating, and implementing software for advanced embedded systems and IoT applications. In addition, these courses convert education in a way that would utilize knowledge and technology both together would make the learning resource a lot more powerful. It offers better community acceptance, a strong impact and even quality result because of which, students will get more chances/possibilities to work in multi-disciplinary areas as IoT is everywhere now. The main reasons for the students to opt for these minor courses are:

- Providing scope to explore the new technologies and applications.
- Opportunities to experience practical Implementation of Core Technologies
- Better Career opportunities

Course Code	Course Title	L	T	P	C
22EC901	Adhoc Sensor Networks	3	0	2	4
22EC902	Design principles of IoT	3	0	2	4
22EC903	Introduction to IoT	3	0	2	4
22EC904	Introduction to IoT Architecture	3	0	2	4
22EC905	Machine learning for IoT systems	3	0	2	4
22EC906	Security aspects of IoT	3	0	2	4
22EC907	Sensors and Actuators for IoT	3	0	2	4

22EC901-ADHOC SENSOR NETWORKS

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE COURSE: Basics of computer networks

COURSE DESCRIPTION:
This course is aimed at offering fundamental concepts of wireless ad-hoc networks and wireless sensor networks. Explore the various MAC routing protocols and their importance for designing of energy efficient and reliable wireless networks.

MODULE-1
UNIT-1   **12L+0T+8P=20Hours**
INTRODUCTION AND ROUTING PROTOCOLS
Introduction to Ad Hoc Networks - Fundamentals of Wireless Communication Technology The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs) :concepts and architectures. Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc and Sensor Networks.

UNIT-2   **12L+0T+8P=20Hours**
MAC PROTOCOLS FOR ADHOC WIRELESS NETWORK
Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11

MODULE-2
UNIT-1   **12L+0T+8P=20Hours**
SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES
Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

UNIT-2   **12L+0T+8P=20Hours**
WSN NETWORKING CONCEPTS AND PROTOCOLS
 MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based   protocols   – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols, Energy Efficient Routing, Challenges, and Issues in Transport layer protocol.

PRACTICES:
Experiments to be carried out in any network simulator like NETSIM, NS2 and OMNET++ etc.
- Examine the various path loss models available for wireless networks
- Identify the various reasons for hidden node terminal problem in wireless ad-hoc networks.
- Create a scenario where both ad-hoc and wireless sensor network are available and examine the interference problem.

- Simulate the MAC routing protocols for wireless sensor networks.
- Simulate the multiple wireless scenarios for throughput performance.
- Analyze performance of the MANET routing protocols in various parameters like end-to-end delay, bit error rate and throughput.
- Design a wireless sensor network and observe how the power consumption consumed for the network.
- Examine the importance of channel accessing mechanism helped for getting high throughput in wireless networks.

SKILLS:
- Identify the various issues and their solutions in for designing wireless networks
- Implement routing algorithms for ad-hoc and sensor networks.
- Develop wireless sensor networks with respect to some protocol design issues.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Realize concepts, network architectures and applications of ad hoc and wireless sensor networks	Apply	1	1, 2, 4, 9, 10, 11, 12
2	Analyze the protocol design issues of ad hoc and sensor networks	Analyze	1	1, 2, 3, 4, 9, 10, 11, 12
3	Evaluate the QoS related performance measurements of ad hoc and sensor networks	Evaluate	2	1, 2, 3, 4, 9, 10, 11, 12
4	Design routing protocols for ad hoc systems.	Create	2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:
1. Carlos Corderio Dharma P. Aggarwal, "Ad-Hoc and Sensor Networks – Theory and Applications", World Scientific Publications, March 2011.
2. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", "Wiley",2005

REFERENCES BOOK:
1. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and P rotocols", Prentice Hall, PTR, 2004.
2. Kazem sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Networks: Technology, Protocols and Application" John Wiley, 2007.
3. C.K Toh, "Ad-Hoc Mobile Wireless Networks: Protocols and Systems" 1st edition, Pearson, 2007.
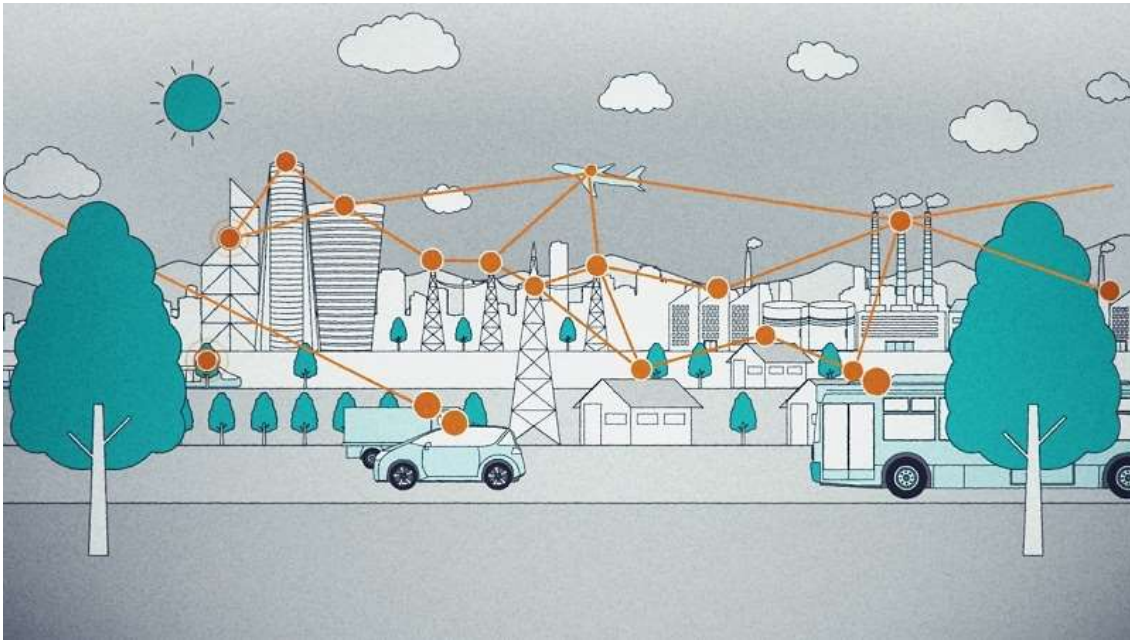
Source: https://www.brainkart.com/subject/Ad-hoc-and-Wireless-Sensor-Networks_363/

22EC902 - DESIGN PRICIPLES OF IoT

Hours per week:			
L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT

COURSE DESCRIPTION AND OBJECTIVES:
This course emphasis on the design principles for developing an IoT product in the market. The objective of the course is to enable the students to understand the design principles while prototyping the IoT devices.

MODULE-1

UNIT-1   **12L+0T+8P=20Hours**
DESIGN PRINCIPLES FOR CONNECTED DEVICES
Introduction, Design Principles for Connected Devices, Calm and Ambient Technology, Magic as Metaphor, Privacy, Web Thinking for Connected Devices, Affordances.

UNIT-2   **12L+0T+8P=20Hours**
PROTOTYPING EMBEDDED DEVICES
Thinking About Prototyping: Sketching, Familiarity, Costs versus Ease of Prototyping, Prototypes and Production, Open Source versus Closed Source, Tapping into the Community.

Prototyping Embedded Devices: Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp, Other Notable Platforms

PRACTICES:
- Sense the available networks using Arduino.
- Detect the vibration of an object using Arduino.
- Connect with the available wi-fi using Arduino.

MODULE-2

UNIT-1   **12L+0T+8P=20Hours**
PROTOTYPING ONLINE COMPONENTS
Prototyping Online Components: Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols

Techniques for Writing Embedded Code: Memory Management, Performance and Battery Life, Libraries, Debugging

UNIT-2   **12L+0T+8P=20Hours**
FROM PROTOTYPE TO REALITY
Business Models, Lean Start-ups, Moving to Manufacture, Designing Kits, Designing Printed circuit boards, Manufacturing Printed Circuit Boards, Ethics, Privacy, Control.

PRACTICES:
- Data Logging with Raspberry pi and Thing speak.
- Turn your smartphone into an IoT device.
- Interfacing Arduino with any cloud platform.

- Measure any physical quantity and tweet when it crossed the threshold limit.

SKILLS:
➢ Design prototypes for IoT applications.
➢ Able to understand the design principle for IoT.
➢ Interface I/O devices with APIs.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Make use of the design principles for connected devices.	Apply	1	1, 2,3,5
2	Able to design the framework necessary for IoT applications	Apply	1	1, 2,3,5, 12
3	Create prototypes for IoT devices	Create	1	1, 2, 3, 5, 12
4	Create APIs for IoT applications.	Create	2	1, 2, 3,12
5	Create business models for IoT.	Create	2	1, 2, 3

TEXT BOOK:
1. Adrian McEwen, "Designing the Internet of Things", Wiley Publishers, 2013.
2. Kamal R. Internet of Things, McGraw Hill, 2017.

REFERENCE BOOKS:
1. Perry Lea, "Internet of Things for Architects", 1st edition, Packt Publishing, 2018.
2. Samuel Greengard, "The Internet of Things (Essential Knowledge)", MIT Press, 2015.
3. Timothy Chou, Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA. April-13 2020.

Source: https://embeddedcomputing.com/technology/iot/device-management/key-areas-to-focus-while-developing-connected-app-for-iot-solutions

22EC903 -INTRODUCTION TO INTERNET OF THINGS

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basic knowledge of internet

COURSE DESCRIPTION AND OBJECTIVES:
This course offers skills on interconnection and integration of the physical world and the cyberspace. The objective of the course is to enable the students to design and develop IoT systems for real-world problems.

MODULE-1
UNIT-1   **12L+0T+8P=20Hours**
IoT INTRODUCTION & CONCEPTS
Introduction: Definition and Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels and deployment.

UNIT-2   **12L+0T+8P=20Hours**
PROTOTYPING & APPLICATIONS
Prototyping Embedded Devices: Electronics, Embedded Computing Basics, Arduino, ESP8266, Raspberry Pi.
Domain Specific Applications of IoT: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

PRACTICES:
- Familiarization with Arduino boards and ESP8266.
- Interfacing of LED and switch with Arduino boards and ESP8266.
- Traffic Light control using Arduino board and ESP8266.
- Interfacing DHT11 sensor with Arduino board and ESP8266.
- Interfacing of ultrasonic sensor with Arduino board and ESP8266.
- Interfacing of PIR sensor with Arduino board and ESP8266.
- DC motor control using L293D motor driver and Arduino board.

MODULE-2

UNIT-1   **12L+0T+8P=20Hours**
INTERNET PRINCIPLES & M2M
Internet Principles: Internet communications: An overview, IP addresses, MAC addresses, TCP and UDP ports, Application layer protocols; Python packages of interest for IoT.

M2M: Introduction to M2M, M2M architecture, Difference between IoT and M2M, SDN and NFV for IoT.

UNIT-2   **12L+0T+8P=20Hours**
IOT DESIGN
IoT Design: IoT Design Methodology, Python Web Application Framework, Django, Designing a REST full web API.

Case Studies: Home Automation, Smart Cities, Environment, Agriculture, Productivity Applications.

PRACTICES:
- Familiarization with Raspberry pi.
- Interfacing of LED and switch with Raspberry pi.
- Interfacing PIR sensor with Raspberry pi.
- Interfacing DHT11 sensor with Raspberry pi.
- Interfacing of ultrasonic sensor with Raspberry pi.
- Interfacing of Picam with Raspberry pi.
- Sending email with Raspberry pi.

SKILLS:
- Use various sensors and actuators for IoT applications.
- Interface programming on I/O devices.
- Develop applications for the Internet of things.

COURSEOUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Interface sensors with various embedded devices.	Apply	1	1, 2,5,12
2	Design the framework necessary for IoT applications	Apply	1	1, 2, 5, 12
3	Develop prototypes for IoT devices	Apply	1	1, 2, 3, 5, 12
4	Assess various internet principles and M2M technologies.	Apply	2	1, 2, 12
5	Classify various advanced IoT applications and case studies.	Apply	2	1, 2

TEXT BOOKS:
1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things A Hands-On-Approach", 2014.
2. Adrian McEwen, "Designing the Internet of Things", Wiley Publishers, 2013.

REFERENCE BOOKS:
1. Perry Lea, "Internet of Things for Architects", 1st edition, Packt Publishing, 2018.
2. Samuel Greengard, "The Internet of Things (Essential Knowledge)", MIT Press, 2015.
3. Timothy Chou,. Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA. April-13 2020.

Source: https://www.freecodecamp.org/news/introduction-to-iot-internet-of-things/
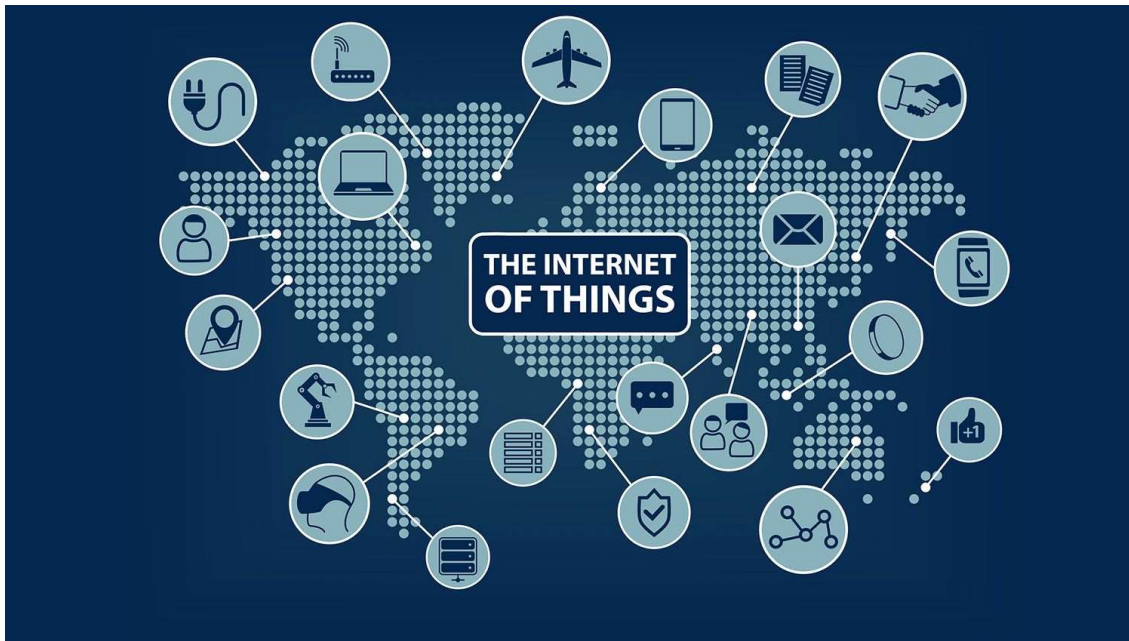
22EC904-INTRODUCTION TO IoT ARCHITECTURE

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT

COURSE DESCRIPTION AND OBJECTIVES:
This course introduces the Architecture of IoT, basic concepts of IoT architectures and IoT Levels**.** The Course emphasizes the constraints, requirements, and architectures of hardware and software components for IoT systems. By the end of the course, a student will be able to: (1) Develop IoT solutions based on popular hardware/software platforms to address real-life problems (2) Evaluate the cost, power, and performance trade-offs associated with IoT solutions

MODULE-1

UNIT-1   **12L+0T+8P=20Hours**
IoT REFERENCE MODELS
Introduction: Introduction to IoT, Applications of IoT, Use cases of IoT, The IoT Architectural Reference Model as Enabler,
IoT in Practice: Examples: IoT in Logistics and Health, IoT Reference Model: Domain, information, functional & communication models.

UNIT-2   **12L+0T+8P=20Hours**
IoT ARCHITECTURE AND PROTOCOLS
IoT Reference Architecture: Architecture, Functional, information, deployment and operation views; SOA based Architecture, API-based Architecture, OPENIoT Architecture for IoT/Cloud Convergence.

Application Protocols for IoT: UPnP, CoAP, MQTT, XMPP. SCADA, WebSocket; IP-based protocols: 6LoWPAN, RPL; Authentication Protocols; IEEE 802.15.4.

Case study: Cloud-Based Smart-Facilities Management, Healthcare, Environment Monitoring System.

PRACTICES:
- Implementation of home automation system using relay module.
- Implementation of traffic signal control using 6LoWPAN.
- Implementation of railway gate control by stepper motors.
- Direction and speed control of DC Motor.
- Familiarization with Arduino/Raspberry pi.
- To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn on led for 1sec after every 2 seconds.
- Write a program on Arduino/Raspberry Pi to publish temperature data to the MQTT broker.
- Write a program on Arduino/Raspberry Pi to subscribe to the MQTT broker for temperature data and print it.

MODULE-2

UNIT-1   **12L+0T+8P=20Hours**
IoT REFERENCE ARCHITECTURE
IIoT Architecture: The IIC Internet Reference Architecture, Industrial Internet Architecture
Framework (IIAF), Architectural Topology, The Three-Tier Topology, Connectivity, Key
System Characteristics, Data Management.

UNIT-2   **12L+0T+8P=20Hours**
DESIGNING INDUSTRIAL INTERNET SYSTEMS
The Concept of the IIoT, The Proximity Network, WSN Edge Node, Legacy Industrial Protocols,
Modern Communication Protocols, Wireless Communication Technologies, Proximity Network
Communication Protocols, Gateways Examining the Access Network Technology and Protocols
- The Access Network, Access Networks Connecting Remote Edge Networks

PRACTICES:
- Identify the industrial Sensors
- Interfacing raspberry pi with Boilers
- Implementation of scrolling belt using raspberry pi.
- implementation of the network using raspberry pi.
- To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data
  to the smartphone using Bluetooth.
- To interface node MCU with Arduino/Raspberry Pi and write a program to send sensor
  data to the smartphone using Blynk Application/Cloud.

SKILLS:
- Understand the specifications and how well different components work together for IoT
  Boards.
- Learn different data and number representations.
- Design ALU and Control unit.
- Identify the types of IoT application protocols and their uses.
- To enable the students to take up the real-time industry as well as interdisciplinary projects.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Build the IoT Design with sensors and actuators and analyse the levels of Arduino programming language.	Apply	1	1, 2, 12
2	Make use of sensors for collection data from the physical medium	Apply	1	1, 2, 5, 12
3	Apply the physical layer issues, analyse Medium Access Control Protocols/IoT Protocols	Apply	1	1, 2, 3, 5, 12
4	Categorize various topologies and Data management tools	Analyze	2	1, 2, 12

5	Comprehend network and transport layer characteristics and protocols and implement conventional protocols	Analyze	2	1, 2

TEXT BOOKS:
1. Giacomo Veneri; Antonio Capasso, "Hands-on Industrial Internet of Things: create a powerful Industrial IoT infrastructure using Industry 4.0", Packt Publishing, 2018
2. Vijay Madisetti, ArshdeepBahga," Internet of Things A Hands-On-Approach",2014

REFERENCE BOOKS:
1. Bassi, Alessandro, et al, "Enabling things to talk", Springer-Verlag Berlin An, 2016.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017
3. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011.
4. Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016
5. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things" by, ISBN: 978-1-4842-2046-7, APRESS, 2016.
6. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", 1 st Edition, Apress Publications, 2013

Source: https://www.scnsoft.com/blog/iot-architecture-in-a-nutshell-and-how-it-works
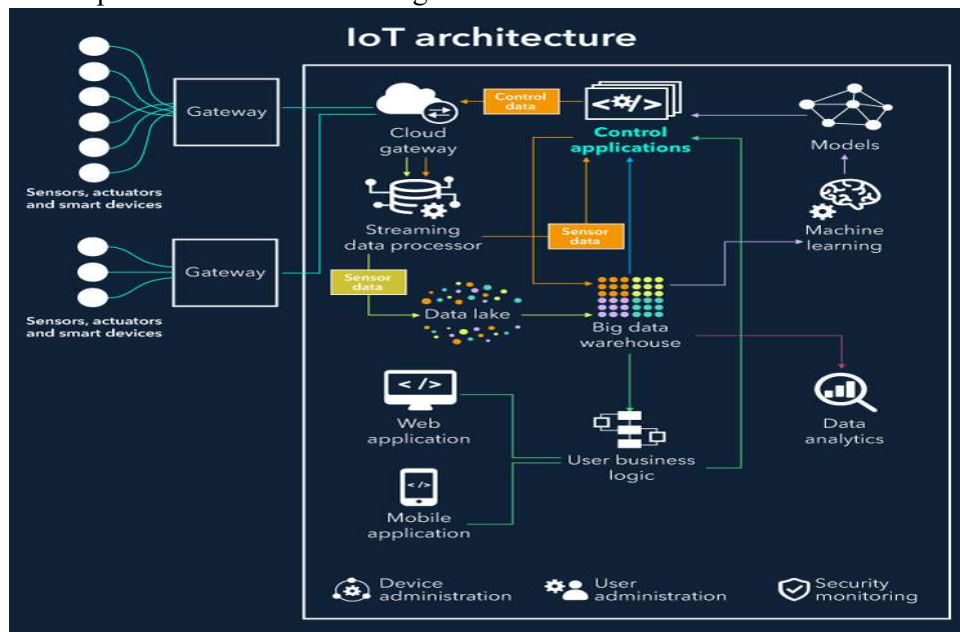
22EC905 -MACHINE LEARNING FOR IoT SYSTEMS

Hours per week:			
L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to IoT

COURSE DESCRIPTION AND OBJECTIVES

Machine learning can help demystify the hidden patterns in IoT data by analyzing massive volumes of data using sophisticated algorithms. Machine learning inference can supplement or replace manual processes with automated systems using statistically derived actions in critical processes. Machine learning for IoT to perform predictive capabilities on a wide variety of use cases that enable the business to gain new insights and advanced automation capabilities.

MODULE-1

UNIT-1   **9L+0T+6P=15 Hours**

INTRODUCTION

Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabaled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates.

UNIT-2   **15L+0T+10P=25 Hours**

Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

M2M to IoT- An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

PRACTICES:

- Establish a sense of relationship of all variables with one other in IRIS dataset. (Multivariate Analysis).
- Analyse individual variables for better understanding using IRIS dataset. (Univariate Analysis).
- Linear regression for Housing data set to predict the price of the house.

MODULE-2

UNIT-1   **9L+0T+6P=15 Hours**

Introduction to Machine Learning: Definition of learning systems. Goals and applications of machine learning, Supervised Learning, Unsupervised Learning, Bias-variance trade-off, Overfitting, under fitting, Gradient descent: -batch, stochastic, Model Evaluation, trees and ensembles, Support vector machines, Working with Text Data

UNIT-2   **15L+0T+10P=25 Hours**

AUTOMATION SYSTEMS USING ML AND IOT

Analysis of systems using ML and IoT- Data collection, data processing and Analysis- CCTV data analysis, smart cities, smart fish system etc

PRACTICES:

- Implement k-nearest neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.

- Use appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
- Splitting the data into training and test data sets using K-fold cross-validation
- Regression problems using XGBoost.

SKILLS:
- Ingest and transform data into a consistent format
- Work with various communication technologies and sensors
- Build a machine learning model
- Apply an appropriate ML algorithm to a specific task
- Deploy this machine learning model on cloud, edge and device

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse various IoT based smart systems.	Apply	2	1, 2, 3, 4, 9, 10, 11, 12
2	Analyse concise manner how the general Internet as well as Internet of Things work.	Analyse	1	1, 2, 3, 4, 9, 10, 11, 12
3	Analyse constraints and opportunities of wireless and mobile networks for Internet of Things.	Analyse	1	1, 2, 3, 4, 9, 10, 11, 12
4	Evaluate various Ml algorithms to various applications	Evaluate	2	1, 2, 3, 4, 9, 10, 11, 12

TEXT BOOKS:
1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2. Introduction to Statistical Learning by Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani. Springer, 2013. Corrected 8th printing, 2017

REFERENCE BOOKS:
1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. Ammar Rayes, Samer Salam, "Internet of Things from Hype to Reality", Springer, 2022.

Source: https://www.scnsoft.com/blog/iot-systems-classification

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to Internet of Things.

COURSE DESCRIPTION AND OBJECTIVES:
This course introduces the methodologies of Cyber Physical systems and the basic Trust models of IoT. The course explores on different threads on IoT applications and provides privacy preservation for real time data using Attack detection techniques, Encryption, Hash Function, Elliptic curves, Signature Algorithms, Consensus Algorithms and Secured Access Protocols.

MODULE-1

UNIT-1   **12L+0T+8P=20 Hours**
CYBER PHYSICAL SYSTEMS & THREADS
Introduction to IoT –Cyber Physical Systems: IoT and cyber-physicalsystems, IoT security (vulnerabilities, attacks, and countermeasures), security engineering for IoT development, IoT security lifecycle.

IoT as Interconnection of Threats: Network Robustness of Internet of Things- Sybil Attack Detection in Vehicular Networks- Malware Propagation and Control in Internet of Things- Solution-Based Analysis of Attack Vectors on Smart Home Systems

UNIT-2   **12L+0T+8P=20 Hours**
CRYPTO FOUNDATIONS & BLOCK CHAIN
Crypto Foundations: Block ciphers, message integrity, authenticated encryption, hash functions, Merkle trees, elliptic curves, public-key crypto (PKI), signature algorithms
Block Chain: Crypto-currencies, Bitcoin P2P network, distributed consensus, incentives and proof-of-work, mining, script and smart contracts, wallets: hot and cold storage, anonymity, altcoins.

PRACTICES:
- Implement Block Cipher Encryption.
- Analyze Attacks on smart Home
- Vulnerabilities on IoT devices.
- Implement attacks on IoT.
- Evaluate Cyber-physical systems.
- Design smart contract for real time IoT applications.
- Implement Consensus Algorithm for IoT.
- Implement Sybil Attack Detection.
- Implement Malware Control in Internet of Things.
- Implement elliptic curve cryptography.

UNIT-1   **12L+0T+8P=20 Hours**
PRIVACY PRESERVATION & TRUST MODELS
Privacy Preservation for IoT: Privacy Preservation Data Dissemination- Privacy Preservation
Data Dissemination- Social Features for Location Privacy Enhancement in Internet of Vehicles-
Lightweight and Robust Schemes for Privacy Protection in Key Personal IoT Applications:
Mobile WBSN and Participatory Sensing

Trust Models for IoT: Authentication in IoT- Computational Security for the IoT- Privacy-
Preserving Time Series Data Aggregation- Secure Path Generation Scheme for Real-Time Green
Internet of Things- Security Protocols for IoT Access Networks- Framework for Privacy and
Trust in IoT- Policy-Based Approach for Informed Consent in Internet of Things

UNIT-2   **12L+0T+8P=20 Hours**
INTERNET OF THINGS SECURITY
Security and Impact of the Internet of Things (IoT) on Mobile Networks- Networking Function
Security-IoT Networking Protocols, Secure IoT Lower Layers, Secure IoT Higher Layers, Secure
Communication Links in IoTs, Back-end Security -Secure Resource Management, Secure IoT
Databases, Security Products-Existing Test bed on Security and Privacy of IoTs, Commercialized
Products.

PRACTICES:
- Implement IoT Networking protocols.
- Implement authorized login for IoT database.
- Secured IoT Access Networks.
- Security implementation at Lower Layers.
- Security implementation at Higher Layers.
- Design light weight security applications.
- Design policy for IoT data Approach.

SKILLS:
➢ Understands the state-of-the-art methodologies in Cyber Physical system.
➢ Knowledge on Model threats and countermeasures.
➢ Explores the Privacy Preservation and Trust Models in Internet of Things (IoT)
➢ Designs Internet of Things Security in the real world scenarios

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Model IoT to business	Apply	1	1, 2, 3, 5
2	Customize real time data for IoT applications.	Apply	2	1, 2, 12
3	Build security systems using elementary blocks	Apply	2	1, 2, 3, 5
4	Identify the areas of cyber security for the Internet of Things.	Analyze	1	1, 2

5	Assess different Internet of Things technologies and their applications.	Analyze	1	1, 2, 12
6	Solve IoT security problems using light weight cryptography	Analyze	2	1, 2, 3, 5

TEXT BOOKS:
1. Hu, Fei. Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations, 1st Edition, CRC Press, 2016.
2. Russell, Brian, and Drew Van Duren. Practical Internet of Things Security, 1 st edition, Packt Publishing Ltd, 2016.

REFERENCE BOOKS:
1. Whitehouse O. Security of things: An implementers' guide to cyber-security for internet of things devices and beyond, 1 st edition, NCC Group, 2014
2. DaCosta, Francis, and Byron Henderson. Rethinking the Internet of Things: a scalable approach to connecting everything, 1 st edition, Springer Nature, 2013.
3. Patel Chintan, Nishant Dosji. Internet of Things Security Challenges, Advances and Analysis, 1st Edition, Auerbach, 2018.

Source: https://www.wsj.com/articles/BL-CIOB-8241
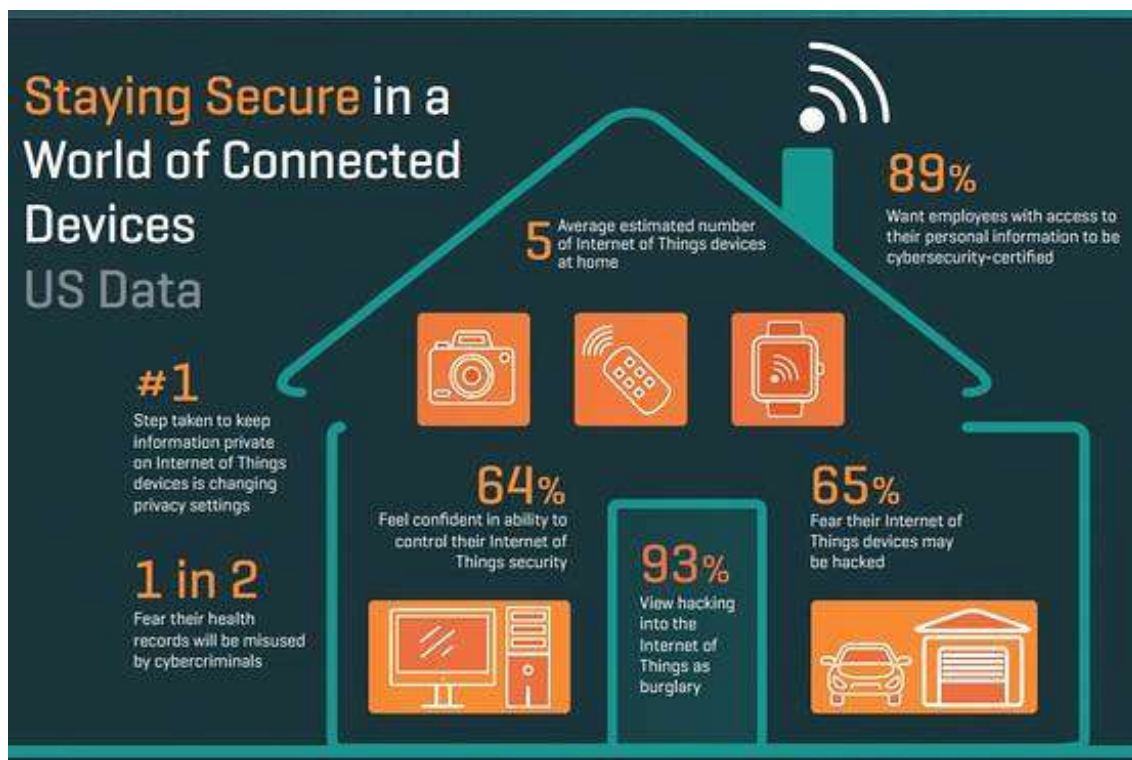
22EC907-SENSORS AND ACTUATORS FOR IoT

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE COURSE: Introduction to IoT or Embedded Systems

COURSE DESCRIPTION AND OBJECTIVES:
Explore IoT smart sensor and actuator solutions. Compare types and technical requirements and protocols across market industries. Develop solutions for IoT using various sensors and actuators.

MODULE-1

UNIT-1   **12L+0T+8P=20 Hours**
INTRODUCTION TO SENSORS & ACTUATORS
Definitions, Classification of sensors and Actuators, General Requirement for interfacing, Units. Input output characteristics, Transfer function, Range, Span, input and Output full scale, resolution and dynamic range, accuracy, errors, and repeatability, sensitivity and sensitivity analysis, hysteresis, nonlinearity, and saturation, Frequency response, response time, and bandwidth, Calibration, excitation, deadband, reliability.

UNIT-2   **12L+0T+8P=20 Hours**
PRINCIPLES OF SENSORS
Principles of sensing (Basics): Capacitance, Magnetism, Resistance, Induction, Piezoelectric effect, Hall effects, Thermoelectric Effects
Ultrasonic Detectors, Optoelectronic Motion Detectors, Optical Presence Sensors, Pressure-Gradient Sensors, 2-D Pointing Devices, Gesture Sensing (3-D Pointing), Tactile Sensors

PRACTICES:
- Find the input characteristics of capacitive sensors
- Measure the range, sensitivity hysteresis, nonlinearity of temperature sensors
- Measure the frequency response of temperature sensor
- Measure the range of optical sensors and calibrate its use for displacement measurement.
- Calibrate a hall effect sensor
- Measure the displacement range, linearity, frequency response of piezoelectric sensor
- Measure the sensitivity of resistance sensors and establish their input characteristics
- Establish sensitivity, range, linearity and frequency response of tactile sensors.

MODULE-2

UNIT-1   **12L+0T+8P=20 Hours**
INTERFACING ELECTRONICS FOR SENSORS
Signal Conditioners: Input Characteristics, Amplifiers, Operational Amplifiers, Voltage Follower, Charge- and Current-to-Voltage Converters, Light-to-Voltage Converters, Capacitance-to-Voltage Converters, Closed-Loop Capacitance-to-Voltage Converters
Data Acquisition: Data Acquisition, Sensor Classification, Units of Measurements
Analog-to-Digital Converters: Basic Concepts, Digital to analog converters, V/F Converters, PWM Converters, R/F Converters, Successive-Approximation Converter, Resolution Extension, ADC Interface

UNIT-2   **12L+0T+8P=20 Hours**

ACTUATORS & INTERFACING

Thermal actuators, Optical actuators, Capacitive actuators, Magnetic actuators, magnetrostrictive actuators, Acoustic actuators, Electromagnetic actuators (DC, Stepper motors) and their control principles Interfacing to microprocessor/microcontrollers. Microprocessor as general-purpose controller, General requirements for interfacing sensors and actuators. Interfacing examples

PRACTICES:
- Develop signal conditioning circuit for low level signals along with noise removal
- Develop a digital circuit for amplification of the capacitive sensor and establish various characteristics.
- Develop a digital circuit for measuring the optical sensitivity of optical sensor
- Control the rotation of stepper motor to precise angle without any sensors
- Tracking object by controlling servo motor precisely

SKILLS:
- Use various sensors and actuators for IoT applications.
- Interface programming on I/O devices.
- Develop applications for the Internet of things.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify sensors for selection of a specific physical parameter	Apply	1	1, 2, 12
2	Control various actuators	Apply	2	1, 2, 3, 5, 12
3	Interface the sensor with different data acquisition systems	Create	2	1, 2, 5, 12
4	Design a signal conditioner for the given sensor	Create	2	1, 2, 12
5	Select a sensor for a given application based on its principle of operation	Evaluate	1	1, 2

TEXT BOOKS:
1. Nathan Ida, Senosrs, Actuators, and Their Interfaces-A Multideisciplinary introduction, 2nd Edition, IET London UK, 2020
2. Jacob Fraden, Handbook of Modern Sensors Physics, Designs, and Applications, Fifth Edition, Springer, 2016

REFERENCE BOOKS:
1. John G. Webster, The Measurement Instrumentation and Sensors, CRC Press, 1999
2. Francisco André Corrêa Alegria, Sensors and Actuators, World Scientific Publichisng Co. Pvt. Ltd., 2022.
3. Ammar Rayes, Samer Salam, "Internet of Things from Hype to Reality", Springer, 2022.

Source: https://www.iotforall.com/an-introduction-to-iot-sensors

MINOR ON ALTERNATE ENERGY TECHNOLOGIES
Offered by Department of Electrical and Electronics Engineering

Not long ago, any mention of Renewable Energy used to be dismissed with scorn as a wishful thinking. But now there is a visible change in the mindset of planners and policy-makers in its favour. Spurred by environmental concerns the developed countries have stepped up efforts to increase the share of renewables in meeting their energy requirements, besides offering financial and technical assistance to the developing countries to develop the Renewable Energy sector. There is now a global commitment to reduce the Green House gases emission level. Multilateral agencies, like the World Bank, Asian Development Bank, Global Environment Facility have come forward to finance Renewable Energy Projects. Worldwide installation of Renewable Energy Power Plant has crossed 3,80,000 MW. These developments are of great significance to our country endowed, as it is, with a variety of renewable energy sources in an abundant measure, besides a committed government to exploit their full potential.

India will need an installed capacity of Power to the extent of 9,00,000 MW by the year 2030-31. Out of which about 2,00,000 MW is likely to come from Renewable Energy Sources. In addition the country will require huge Biofuel in the transport sector also. This will create a large number of jobs in this emerging sector. According to National Renewable Energy Laboratory (NREL) estimates, solar power has the highest employment generation potential amongst all sources of power generation. As per their analysis, in 2008 almost 28 jobs/MW were created in Solar PV and 24 jobs/ MW were created in Solar CSP. Solar Water Heater could create half a million job by the year 2024. Solar powered agricultural pump sets could create 50,000 jobs in next 10 years time.

India's Clean Revolution Promises Employment to 6.5 million India's emerging green job sector holds out the promise of 6.5 million jobs by the end of the decade as investments in energy efficiency and renewable energy technologies like solar, wind and biofuels. According to the report released by the climate group, wind sector could create between 1,50,000 to 2,50,000 jobs by the year 2024. Similarly, the solar industry could generate between 1,17,000 to 2,35,000 jobs. About 5 million jobs could come from growing biofuels. Need of the hour is to set up large number of Clean Energy Education Centre in the country. India must have competent people in Renewable Energy sector to achieve the target of National Solar Mission, Enhanced Energy Efficiency Mission and also to a large extent Sustainable Habitat Mission.

Minor degree in Alternate Energy Technolgies is to train students in the specialized subjects in this field, like Design of PV system for residential, commercial & industrial appliations design of wind & biomass systems, conduction of energy audit, cost-benefit & life cycle analysis of alternate energy systems and corresponding hands on / simulation in their areas.

Sub.Code	Subject Name	L	T	P	C
22EE901	Principles of Solar Energy	3	2	0	4
22EE902	Fundamentals of Solar PV Systems	3	2	0	4
22EE903	New & Renewable Energy Technologies	3	2	0	4
22EE904	Energy System Economics	3	2	0	4
22EE905	Principles of Energy Management and Audit	3	2	0	4

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basic Physics

COURSE DESCRIPTION AND OBJECTIVES:
This course is aimed at familiarizing the students with the characteristics of solar radiation, its global distribution, and measurement of solar radiation. In this subject students will learn the fundamentals, characteristics, parameters and types of solar PV cells002E

MODULE–1

UNIT-1   **12L+8T+0P=20 Hours**
SOLAR RADIATION AND MEASUREMENT:
Indian energy scenario, Global solar resources, solar radiation on the earth surface, solar radiation measuring instruments, Local apparent time.

UNIT-2   **12L+8T+0P=20 Hours**
SOLAR RADIATION GEOMETRY AND CALCULATIONS:
Solar radiation geometry, sun-earth angles, calculation of angle of incidence, solar day length, angstroms equation.

PRACTICES:
- Estimate the amount of solar energy intercepted by the Earth.
- Measure the solar radiations on a given day and plot the hourly variations.
- Predict the variation of solar radiation with day of a year.
- Calculate the variation of sun-earth angles with day of a year.
- Effect of variation in tilt angle on PV module power.

MODULE–2

UNIT-1   **16L+8T+0P=24 Hours**
SOLAR CELL FUNDAMENTALS:
Photovoltaic effect, solar cell structure. Parameters of a solar cell, parasitic resistances, I-V characteristics, effect of irradiation and temperature.

UNIT-2   **8L+8T+0P=16 Hours**
TYPES OF SOLAR CELLS:
Single crystalline, multi crystalline and amorphous solar cells, CdTe and CIGS solar cells, introduction to multi junction solar cells.

PRACTICES:
- Measurement of Voltage and Current of Solar Cells.
- Obtain the I-V and P-V characteristics of PV cell.
- Demonstrate the I-V and P-V characteristics of PV cell with varying radiation level.
- Demonstrate the I-V and P-V characteristics of PV cell with varying temperature level.

SKILLS:
- ➢ Prioritizing the usage of solar radiation measuring instruments.
- ➢ Calculate different sun-earth angles.
- ➢ Analyze the performance of PV cell looking at its I-V characteristics.
- ➢ Interpret the effect of various parameters on the performance of a solar cell.
- ➢ Predict the variation of solar radiation with day of a year.
- ➢ Validate the I-V curves of a solar cell at different radiation levels.
- ➢ Validate the I-V curves of a solar cell for varying temperatures.
- ➢ Fabricate a solar powered LED light.

COURSE OUTCOMES:
Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Prediction of solar radiation on a particular day	Analyze	1	1,2,3,4,6,7
2	Analyze the effect of various parameters on the performance of a solar cell	Analyze	1,2	1,2,3,4,5,6,7
3	Selecting a type of solar cell for a particular application.	Analyze	1,2	1,2,4,5,6,7
4	Choosing the instrument for measuring the relevant solar radiation data	Evaluate	1	1,2,4,5,6,7

TEXT BOOKS:
1. Chetan Singh Solanki., Solar Photovoltaic: "Fundamentals, Technologies and Application", PHI Learning Pvt., Ltd., 2009.
2. Sukhatme. S. P, Nayak. J. K, "Solar Energy", Tata McGraw Hill Education Private Limited, New Delhi, 2010.

REFERENCE BOOKS:
1. Chetan Singh Solanki., "Solar Photovoltaic Technology and Systems: A Manual for Technicians" PHI Learning Pvt., Ltd., 2013.
2. Jha. A. R, "Solar Cell Technology and Applications", CRC Press, 2010.
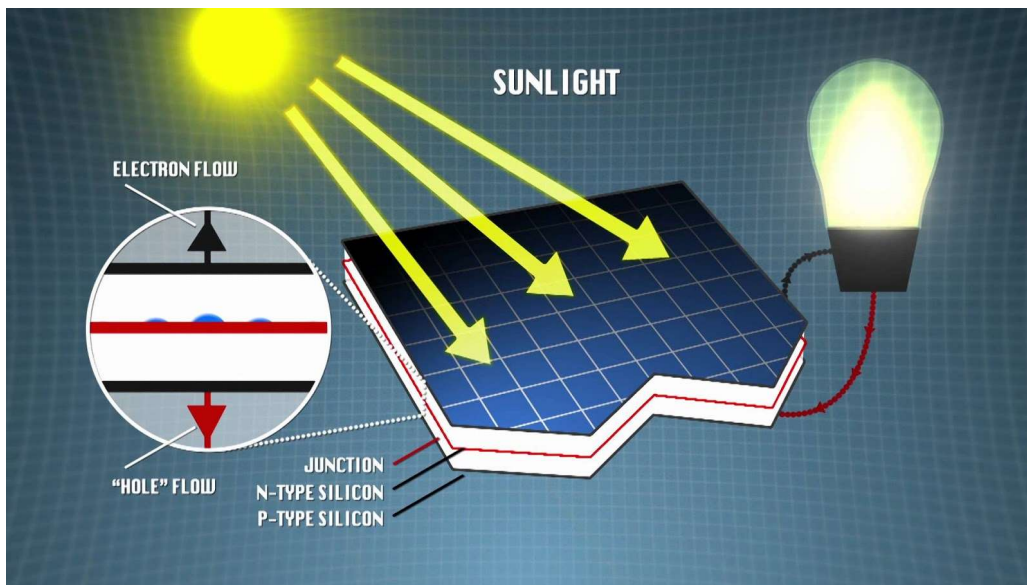
Source: https://www.engineerwing.com/2017/06/operating-principle-of-solar-panel-and.html

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basic Physics, Basics of Electrical & Electronics Engineering.

COURSE DESCRIPTION AND OBJECTIVES:
This course is aimed at familiarizing the students with the design aspects of solar cell, series and parallel connection of solar cells, I-V characteristics of a PV module. In this subject students will learn the sun tracking mechanisms, emerging solar cell technologies and PV system applications.

MODULE–1
UNIT-1   **12L+8T+0P=20 Hours**
SOLAR PV MODULE:
Series and parallel connection of solar cells, shading, hot spots, ratings and I-V characteristics of a PV module, bypass diode and blocking diode.

UNIT-2:   **12L+8T+0P=20 Hours**
BALANCE OF PV SYSTEM:
Classification of PV systems, PV system components, Battery energy storage, Introduction to MPPT algorithms.

PRACTICES:
- Demonstrate the I-V and P-V characteristics of PV module with varying radiation and temperature level
- Demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules.
- Demonstrate the effect of shading on module output power.
- Demonstrate the working of diode as bypass diode and blocking diode in a PV module.
- Obtain the charging and discharging characteristics of a battery.

MODULE–2
UNIT-1   **16L+8T+0P=24 Hours**
DESIGN OF PV SYSTEMS:
Design of solar PV lantern, stand alone PV system, solar water pumping systems.

UNIT-2   **8L+8T+0P=16 Hours**
PV SYSTEM APPLICATIONS AND EMERGING SOLAR CELL TECHNOLOGIES:
PV System Applications: Building-integrated photovoltaic units, solar lamps, solar street lights, solar water pumps, solar cars, aircraft, space solar power satellites.
Emerging Solar Cell Technologies: Organic solar cells, Dye-synthesized solar cells, GaAs solar cells, Thermo Photovoltaics, Concentrated Photovoltaics

PRACTICES:
- Workout power flow calculations of standalone PV system of DC load with and without battery.

- Workout power flow calculations of standalone PV system of AC load with and without battery.
- Workout power flow calculations of standalone PV system of DC and AC load with and without battery.
- Review the different emerging solar cell technologies.
- Review the various applications of PV system.

SKILLS:
- Distinguish between series and parallel combination of PV modules.
- Analyze the effect of shading on module output power.
- Design a solar PV system for a particular application.
- Justify the need of various solar cell technologies.
- Validate the I-V curves of a solar module at different radiation levels.
- Validate the I-V curves of a solar module for varying temperatures.
- Obtain the I-V and P-V characteristics of series and parallel combination of PV modules
- Design a solar PV system for any stand alone application.

COURSE OUTCOMES:
Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the effect of various parameters on the performance of a solar module	Analyze	1,2	1,2,3,4,5,6,7
2	Classify the Solar PV systems based on requirements	Analyze	1,2	1,2,4,6,7
3	Review the various applications of PV system.	Evaluate	2	1,2,4,5,6,7
4	Design a Solar PV system	Create	2	1,2,3,4,5,6,7.9.12

TEXT BOOKS:
1. Chetan Singh Solanki., Solar Photovoltaic: "Fundamentals, Technologies and Application", PHI Learning Pvt., Ltd., 2009.
2. Jha. A.R, "Solar Cell Technology and Applications", CRC Press, 2010.

REFERENCES:
1. Chetan Singh Solanki., "Solar Photovoltaic Technology and Systems: A Manual for Technicians" PHI Learning Pvt., Ltd., 2013.
2. Sukhatme. S. P, Nayak. J. K, "Solar Energy", Tata McGraw Hill Education Private Limited, New Delhi, 2010.
3. John R. Balfour, Michael L. Shaw, Sharlave Jarosek., "Introduction to Photovoltaics", Jones & Bartlett Publishers, Burlington, 2011.
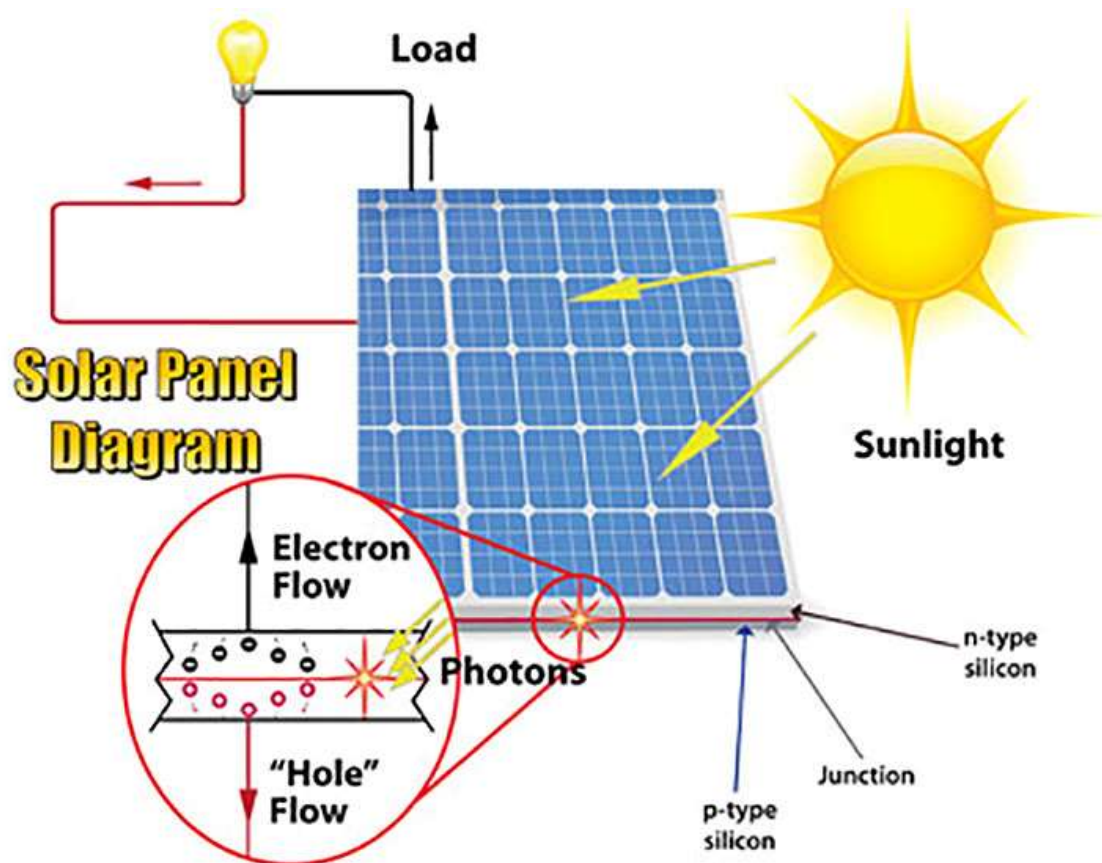
Source: https://etap.com/renewable-energy/photovoltaic-array-fundamentals

22EE903 - NEW & RENEWABLE ENERGY TECHNOLOGIES

L	T	P	C
3	2	0	4

Hours per week:

PREREQUISITE KNOWLEDGE: Basic Engineering Products

COURSE DESCRIPTION AND OBJECTIVES:
This course deals with the types, purpose and operation of renewable energy technologies. The objective of the course is to understand the implementation of wind energy, geothermal energy, ocean energy and biomass energy resources.

MODULE –1

UNIT-1   **12L+8T+0P=20 Hours**
WIND ENERGY:
Nature of wind, Site selection, Principle of wind energy conversion, Betz limit, Power regulation, Classification of wind mills, aero dynamics, Design of wind turbine for water pumping applications.

UNIT-2   **12L+8T+0P=20 Hours**
BIOMASS:
Photosynthesis, Biomass energy conversion technologies, Design of biogas plant.

PRACTICES:
- Familiarization with wind energy gadgets
- Study of wind turbine system for water pumping application
- To study biogas plants
- Study of different types of Gasifiers

MODULE –2

UNIT-1   **12L+8T+0P=20 Hours**
GEOTHERMAL ENERGY:
Introduction, geothermal energy resources, direct heat applications, geothermal power plants.

UNIT-2   **12L+8T+0P=20 Hours**
TIDAL ENERGY:
Spring tide, Neap tide, Daily and monthly variation, Tidal range, Modes of tidal power generation, Types of tidal power plants - single basin and double basin schemes.

PRACTICES:
- Familiarization with Geothermal and tidal energy gadgets
- Ocean thermal energy conversion plants: a study of mixing and recirculation
- Study on throttle valve function in the process of wave energy conversion

SKILLS:
➢ Identify different types of Renewable energy resources.
➢ Understand layout and functioning of wind power plants.
➢ Differentiate between various biomass energy conversion routes.

- Understand layout and functioning of Geothermal energy conversion system.

ACTIVITIES:
- Design prototype of wind energy conversion system
- Design prototype biogas plant.
- Review the technical aspects of ocean energy in the World.

COURSE OUTCOMES:
Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Choose different components and their functioning in wind power plants	Apply	1	1,2,3,4,5,7
2	Choose the components and operation of biomass plant	Apply	2	1,2,3,4,5,7,9,11
3	Analyse the working different wind energy conversion technologies	Analyze	1	1,2,3,4,5,7
4	Analyse the operation of OTEC power plants	Analyze	2	1,2,3,4,5,7,9,11
5	Compare the operation of tidal power generation	Analyze	2	1,2,3,4,5,7,9,11

TEXT BOOKS:
1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", 1st edition, Oxford University Press, 2012.
2. G. S. Sawhney, "Non-Conventional Energy Resources", 1st edition, PHI Learning, 2012.

REFERENCES BOOKS:
1. S.P. Sukhatme and J.K. Nayak., "Solar Energy", 3rd edition, Tata Mc-Graw Hill Education Private Limited, 2010.
2. Chetan Singh Solanki, "Solar Photovoltaic: Fundamentals, Technologies and Application", PHI Learning Pvt., Ltd., 2009.
3. Rajput R.K., "Non-Conventional Energy Sources and Utilization", revised edition, S. Chand & Co., 2012.
4. B.K Khan., "Non-Conventional Energy Resources", 3rd edition, McGraw Hill Education India Private Limited; 2017.
5. G.D. Rai, "Non-Conventional Energy Sources", 4th edition, Khanna Publishers, 2011.

Source: https://www.pinterest.com/pin/renewable-energy-technology-green-sustainable-development--882353751965356880/

22EE904 - ENERGY SYSTEM ECONOMICS

PREREQUISITE KNOWLEDGE: Principles of Management.

COURSE DESCRIPTION AND OBJECTIVES:
This course deals with the economic concepts and theories related to the supply and utilization of energy resources and technologies at various levels – economy, firm and individual. The objective of the course is to introduce economic tools, empirical data for economic analysis in the energy system domain to support and influence the decision making in the context of resource planning and energy efficiency to take economically sound decisions.

MODULE-1
UNIT-1   **12L+8T+0P=20 Hours**
ENERGY AND ECONOMICS AND VALUE ENGINEERING:
Energy and Economics: Flow in an economy, Law of supply and demand, Engineering efficiency, Economic efficiency, Element of costs, Break-even analysis and V-ratio.
Value Engineering: Make or buy decision, Interest formulae, Time value of money Effective interest rate.

UNIT-2   **12L+8T+0P=20 Hours**
CASH FLOW:
Present worth method, Future worth method, Annual equivalent method, Rate of return method, Benefits/Cost Ratio method, NPV, IRR, Payback period, LCC.

PRACTICES:
- Overview of energy scenario and introduction to energy conservation
- Energy management concept, principles, benefits and its significant.
- Energy conservation system a case study

MODULE-2
UNIT-1   **12L+8T+0P=20 Hours**
REPLACEMENT AND MAINTENANCE ANALYSIS:
Economic life of an asset, Replacement of an asset with a new asset, Capital recovery with return.

UNIT-2   **12L+8T+0P=20 Hours**
DEPRECIATION:
Straight line method of depreciation, Declining balance method of depreciation, Sum of the years digits method of depreciation, Sinking fund method of depreciation / Annuity method of depreciation, Service output method of depreciation.

PRACTICES:
- An approach to study energy audit, energy monitoring and targeting
- Replacement and maintenance analysis in renewable energy system a case study
- Depreciation in renewable energy system a case study

SKILLS:
➢ Compare economic and energy parameter of India with other countries.
➢ Compare various available alternatives.
➢ Perform replacement and maintenance analysis.
➢ Perform life cycle analysis of a product.
➢ Compare economic and energy parameters of India with other countries.
➢ Case study on make or buy decision (Eg: water coolers in VFSTRU).
➢ Case study on economical comparison of solar PV generation and diesel power generation.
➢ Case study on replacement and maintenance of ACs, UPS etc., from VFSTRU.
➢ Life cycle analysis of solar panel.

COURSE OUTCOMES:
Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various economic policies and application of theories	Apply	1	1,5,6,8
2	Analyze financial and economic concepts for a given problem	Analyze	2	1,5,6,8
3	Examine various methods of depreciation	Analyze	2	1,5,6,8
4	Evaluate different alternatives for better economic efficiency	Evaluate	2	1,5,6,8

TEXTBOOKS:
1. Panneer Selvam. R, "Engineering Economics", 1st edition, Prentice Hall of India Ltd, New Delhi, 2001.
2. Subhes C. Bhattacharyya., "Energy Economics", 1st edition, Springer, 2011.

REFERENCEBOOKS:
1. Chan S. Park, "Contemporary Engineering Economics", 1st edition, Prentice Hall of India, 2002.
2. Aswathnarayana U, "Green energy: Technology, Economics and policy", 1st edition, CRC press, 2010.
3. Truett & Truett, "Managerial economics- Analysis, Problems & Cases " Wiley India, 8th edition 2004.
4. Suma Damodaran, "Managerial Economics", 1st edition, Oxford University press, 2006.

Source: https://www.offis.de/en/applications/energy/co-simulation-of-multi-modal-energy-systems.html

Hours per week:

L	T	P	C
3	2	-	4

PREREQUISITE KNOWLEDGE: Power Generation Systems, Electrical Machines.

COURSE DESCRIPTION AND OBJECTIVES:
This course deals with the economic concepts and theories related to the supply and utilization of energy resources and technologies at various levels – economy, firm and individual. The objective of the course is to introduce economic tools, empirical data for economic analysis in the energy system domain to support and influence the decision making in the context of resource planning and energy efficiency to take economically sound decisions.

MODULE–1
UNIT-1   **12L+8T+0P=20 Hours**
BASIC PRINCIPLES OF ENERGY MANAGEMENT:
Energy scenario, Energy Management, Energy Conservation, Energy Audit, Energy Instruments,

UNIT-2   **12L+8T+0P=20 Hours**
CO-GENERATION, TRI-GENERATION AND WASTE HEAT RECOVERY:
Co-generation, Tri-generation and Waste heat recovery Technologies

PRACTICES:
- Energy management concept, principles, benefits and its significant.
- Energy conservation system a case study
- Overview of energy scenario and introduction to energy conservation
- Heat recovery system and its potential opportunities
- Special features of co-generation plants and their types

MODULE –2
UNIT-1   **12L+8T+0P=20 Hours**
ENERGY EFFICIENCY IN ELECTRICAL SYSTEMS AND POWER FACTOR CORRECTION:
Energy Efficiency in Electrical Systems: Modification / Replacement of existing systems, Energy efficient motors, Demand side management Techniques.
Power Factor Correction: Power factor, causes of low power factor, methods of improving power factor.

UNIT-2   **12L+8T+0P=20 Hours**
ENERGY EFFICIENCY IN SPACE HEATING AND VENTILATION:
Water and Space Heating methods**,** Ventilation, Air-conditioning, Energy conservation methods.

PRACTICES:
- Overview of energy scenario and introduction to energy conservation
- Energy management concept, principles, benefits and its significant.
- Energy conservation system a case study

- Analysis of electric bill based on tariff of Industrial consumer to reduce energy usage and electric bill
- Estimate energy saving by improving power factor and load factor a case study
- Prepare a sample energy audit questionnaire for VFSTR, VU facilities

SKILLS:
- Implement the energy conservation measures for various equipment.
- Analyse different lighting schemes.
- Design a capacitor bank for an energy utility.
- Perform energy audit for an energy utility.

ACTIVITIES:
- Survey the air– conditioning systems in VFSTR to implement energy conservation measures.
- Survey the VFSTR to modify the existing lighting schemes.
- Design the capacitor bank for improving the power factor of VFSTR.
- Energy auditing of different blocks in VFSTR.

COURSE OUTCOMES:
Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Make use of a capacitor bank to address low power factor issues	Apply	2	1, 2, 3, 4, 12
2	Make use of energy utilization systems for heat recovery	Apply	2	1, 2, 3, 4, 12
3	Analyse effective energy management policies, methods and planning	Analyze	1	1, 2, 3, 4
4	Carryout energy audit and economic analysis	Analyze	1	1, 2, 3, 4, 11, 12

TEXT BOOKS:
1. W. R. Murphy and F. Mc Kay Butterwort, "Energy Management", 1st edition, Elsevier Publications, 2012.
2. Umesh Rathore, "Energy Management", 2nd Edition, S. K. Kataria & Sons, 2014.

REFERENCE BOOKS:
1. Paul O' Callaghan, "Energy Management", 1st edition, Mc-Graw Hill Book Company, 1998.
2. V.K Mehta and Rohit Mehta, "Principles of Power Systems", 1st edition, S. Chand & Company Ltd., 2009.
3. Reay, D.A., "Industrial Energy Conservation", 1st edition, Pergamon Press, 2003.
4. John. C. Andreas, "Energy Efficient Electric Motors", 2nd edition, Marcel Inc. Ltd., 1995.

Source: https://www.maclead.com/project/energy-management/

MINOR ON ELECTRIC MOBILITY
Offered by Department of Electrical and Electronics Engineering

India is the fifth user of Automobiles in the world and will be coming at position third in the near future. These automobiles are one of the major concerns for carbon emissions. The Indian automotive industry is witnessing a paradigm shift due to the introduction of e-mobility. Electric vehicles have repetitively grown in popularity, and because of their energy efficiency and lower carbon emissions, they are undoubtedly the vehicles of the future.

Tesla, for example, recently surpassed a market capitalization of $100 billion, making it the first publicly traded carmaker in the United States to do so. According to industry experts, the number of electric vehicles on the road in the world will have risen to 18.7 million by 2030, up from around 1 million at the end of 2021.Under the   National Electric Mobility Mission Plan 2020, the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India (FAME India) was launched to offer incentives to electric vehicles. India is aiming to have battery capacity of 158 GWh by the year 2030. Ola Electric is setting the world's largest plant in Hosur near Bengaluru and is expecting to pump out 10 million vehicles annually which form 15% of e-scooters.

Consumers may expect, the introduction of many new enhancements, such as more powerful, longer-lasting batteries; upgraded charging technology; fully functioning autonomous driving; and solar-powered vehicles. Heavy investments are done by renowned companies in electric vehicle technology to improve on above said parameters. There's even a chance that electric planes will become a reality. Major skill enhancements arena in EV Technology are:
• Design and Architecture Control of Electric Vehicle
• Electric Vehicle charging
• Energy Storage and Battery Management System
• Testing and Validation

The three domains of manufacturing EVs and batteries along with developing charging infrastructure in a distributed manner will create many opportunities for job as well as for start-ups in the field of Electric Vehicles. EV growth will be faster in the next coming decade, as the requirement for the alternative fuel for the production and transportation of the goods and people is suffering.

Minor degree in Electric Vehicles is to train the students in the specialized subjects in this field, like Fundamentals of Hybrid and Electric Vehicle, Design, Architecture and Control of EV, Battery Management Systems, Design and Development of Charging Infrastructure and corresponding hands-on/simulation in these areas.

Course Code	Course Title	L	T	P	C
22EE906	Power Electronics for E-Mobility	3	2	0	4
22EE907	Electric Motors and Control	3	2	0	4
22EE908	Electric Vehicles Technology	3	2	0	4
22EE909	Energy Storage and Management System	3	2	0	4
22EE910	EV Charging Infrastructure and BMS	3	2	0	4

22EE906 - POWER ELECTRONICS FOR E-MOBILITY

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of Electrical Engineering

COURSE DESCRIPTION AND OBJECTIVES:
Develop a technical understanding of power electronics to build the skills needed to help accelerate the EV revolution.

MODULE-1
UNIT-1   **12L+8T+0P=20 Hours**
Basic Power Electronic Devices: Diodes, Thyristors, Bipolar Junction Transistors, Metal–Oxide–Semiconductor Field Effect Transistors, Insulated Gate Bipolar Transistors, Ultra-capacitors.

UNIT-2   **12L+8T+0P=20 Hours**
DC/DC Converter: Basic Principle of DC–DC Converter, Step-Down (Buck) Converter, Step-Up (Boost) Converter, Buck–Boost Converter, DC–DC Converters Applied in Hybrid Vehicle Systems, Isolated Buck DC–DC Converter, Four-Quadrant DC–DC Converter.

PRACTICES:
1. Study of characteristics of SCR, MOSFET & IGBT.
2. Gate firing circuits for SCR's.
3. Forced commutation circuits (Class A, Class B, Class C, Class D & Class E).
4. DC-DC non isolated converters (Buck, boost) (MATLAB Simulation & Hardware).

MODULE-2
UNIT-1   **12L+8T+0P=20 Hours**
Rectifiers: Single-phase Diode Rectifiers, Three-phase Diode Rectifiers, Poly-phase Diode Rectifiers, Filtering Systems in Rectifier Circuits, High-frequency Diode Rectifier Circuits.

UNIT-2   **12L+8T+0P=20 Hours**
Inverters: Single-phase Voltage Source Inverters, Three-phase Voltage Source Inverters, Current Source Inverters, Closed-loop Operation of Inverters, Regeneration in Inverters, Multistage Inverters.

PRACTICES:
1. Single phase series inverter with R and RL loads.
2. Single phase parallel inverter with R and RL loads.
3. Single phase fully controlled bridge converter with R and RL loads (MATLAB Simulation & Hardware).
4. Single phase half controlled converter with R load (MATLAB Simulation & Hardware).

SKILLS:
- Design of Power Electronics
- Auxiliary DC-DC converters
- Pulse Width Modulation
- Drive inverters

ACTIVITIES:
- On-board chargers
- Motor design

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Semiconductor devices selection for EVs	Apply	1	1, 2
2	Describe the construction and operation of Converters.	Apply	1,2	1, 3
3	Illustrate the construction and operation of Rectifiers and Inverters.	Create	1,2	1, 2, 3, 4
4	Make use of power electronics components in hybrid electric vehicle and fuel cell vehicle.	Create	1,2	1, 2, 3, 4

TEXT BOOKS:
1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2011.
2. Bhimbhra P.S., "Power Electronics", Khanna Publishers, New Delhi, 2005.

REFERENCE BOOKS:
1. Ali Emadi, "Handbook of Automotive Power Electronics and Drives", Taylor & Francis Group, First Edition, USA, 2005.
2. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education, second Edition, 2003.

Image Source: https://www.nature.com/articles/s41928-021-00710-w

22EE907 - ELECTRIC MOTORS & CONTROL

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of Electrical Engineering

COURSE DESCRIPTION AND OBJECTIVES:
Course objective is to make the students to understand the sizing of Electrical Machines used in Electric vehicle application and analyze the various types of drives used for Electric & Hybrid vehicle application.

MODULE-1

UNIT–1   **12L+8T+0P=20 Hours**
EV Motors Characteristics & DC Motor Operation Characteristics: Requirement of EV motors, DC motor operation and its types, speed-torque relations, Speed control – Armature and field control; - BLDC Motor and Control - Operation of BLDC Motor - Torque and Rotating Field Production – Torque - Speed Characteristics and Typical Technical Parameters - Sensor less BLDC Motor Control.

UNIT-2   **12L+8T+0P=20 Hours**
AC Motor Operation Characteristics: Review of Induction Motor operation – Equivalent circuit – Performance of the machine with variable voltage, rotor resistance variation, pole changing and cascaded induction machines, slip power recovery – Static Kramer Drive. Review and operation Synchronous, Switched Reluctance motor.

Practices:
- Plugging of DC motor.
- Fully controlled converter fed DC motor.
- Static rotor resistance control of induction motor.
- Speed control of induction motor using v/f control method.

MODULE-2

UNIT-1   **12L+8T+0P=20 Hours**
Converter and Chopper Control: Principle of phase control – Series and separately excited DC motor with single phase and three phase converters – waveforms, performance parameters, performance characteristics - Operation with freewheeling diode schemes; Drive employing dual converter. Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control.

UNIT 2   **12L+8T+0P=20 Hours**
VSI and CSI Fed Induction Motor Control: AC voltage controller fed induction machine operation – Energy conservation issues – V/f operation theory – requirement for slip and stator voltage compensation. CSI fed induction machine – Operation and characteristics - PWM controls.

PRACTICES:

- AC voltage controller fed induction motor using anti-parallel SCRs and TRIAC.
- Open loop control of PMSM using voltage source inverter.
- Self control mode of PMSM using cyclo converter.
- DC/DC converter fed DC motor.

SKILLS:

- Suggest suitable converter for speed control of Electric Vehicle.
- Design a converter for given load conditions of DC drive.
- Design a converter for given load condition of AC drive.
- Minimize current / torque ripple in a converter bed electric drive.

ACTIVITIES:

- Suggest a drive for Electric Vehicle.
- Design and testing of portable electric vehicle.

COURSE OUTCOMES:
Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Develop the different Sizing of Electrical machines used in Electric Vehicle.	Apply	1,2	1, 2
2	Analyze suitability of electric motor & their control	Analyse	1,2	1, 3
3	Analyze speed control of Induction motor	Analyse	2	1, 2, 3, 4
4	Analyze Permanent Motor drive control for Electric Vehicle application.	Analyse	1,2	1, 2, 3, 4

TEXT BOOKS:
1. Bimal K. Bose, "Modern Power Electronics and AC Drives", CRC Press, 2001.
2. Janaki, Eswar Press, "Power Electronics and Drives", CRC Press, 2007.

REFERENCE BOOKS:
1. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw Hill, 2000.
2. R. Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice- Hall of India Pvt. Ltd., New Delhi, 2003.
3. Austin Hughes, "Electric Motors and Drives – Fundamentals, Types and Applications", Elsevier – a division of Reed Elsevier India private Limited, New Delhi, 2006.

Image Source: https://www.dfliq.net/electrical-materials-products/motor-control/
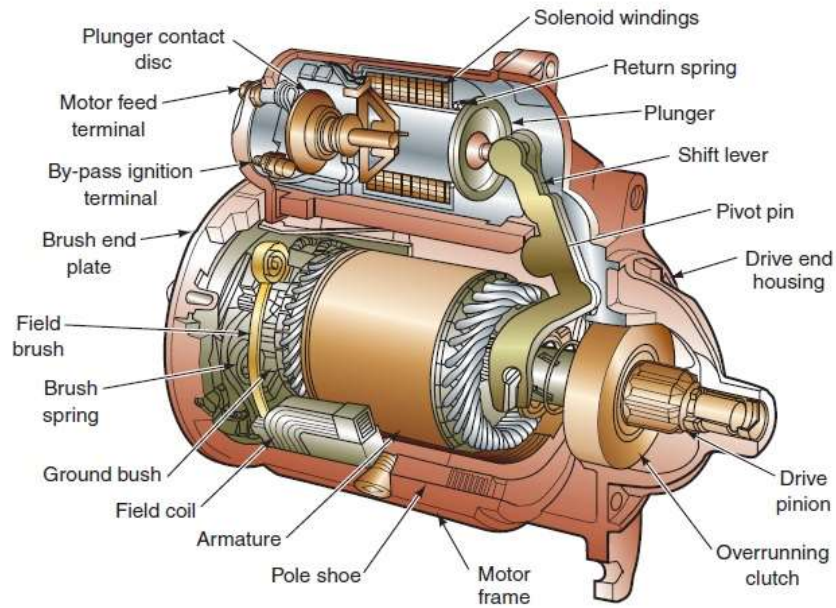
Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basic Electrical & Electronics Engineering; Electrical Machines; Power Electronics

COURSE DESCRIPTION AND OBJECTIVES:

To make students understand the need and importance of Electric, Hybrid Electric Vehicles and Fuel cell vehicle. To differentiate and analyze the various energy storage devices and battery charging and management systems. To impart knowledge about architecture and performance of Electric and Hybrid Vehicles. To classify the different drives and controls used in electric vehicles.

MODULE-1

UNIT-1   **12L+08T+0P=20 Hours**

Overview of EVS and Challenges: Components of EVs - architecture of EVs - EV market and promotion-infrastructure needs - EV makers - Comparison in reference of: Energy source, Pollution, Energy diversification, Efficiency, Capital & operating cost, Performance.

UNIT-2   **12L+08T+0P=20 Hours**

Classification of EVS Reference of -Propulsion devices, Energy sources, Energy carriers, Pure Electric Vehicles (PEV) - Hybrid Electric Vehicles (HEV) and Plug-in Hybrid Electric Vehicles (PHEV) - Configurations: BEV, FCEV.

PRACTICES:

- Developing real-life drive cycles for 2-wheelers, 3-wheelers, cars and buses
- Extracting features from the drive cycles for sizing motors and converters;
- Control of motors using the drive cycles.

MODULE-2

UNIT-1   **12L+08T+0P=20 Hours**

EV Energy Source Technologies: Energy sources used in EVs & HEVs - Medium of power transfer (conductive and wireless) - wireless power transfer - Battery Management System (BMS).

UNIT-2   **12L+08T+0P=20 Hours**

EV Communication: V2V, V2G and its applications in power system - power saving & coordinated charging - layout of power converters for V2G operation - EV configurations: converted & purpose built EVs - components of EV system.

PRACTICES:

- Study of accessories required for Scooter Hybrid Conversion
- Lithium Batteries and Battery Pack Design for Electric & Hybrid Vehicle Application
- Power train Sizing Calculation Procedure and Practice Problems

SKILLS:

- Selection of E – motors for Electric Vehicles- BLDC/PMSM/INDUCTION/SynR MOTORS
- Lithium Batteries and Battery Pack Design for Electric & Hybrid Vehicle Application

- Motor Control Technology for Electric Vehicle applications
- Powertrain Sizing Calculation Procedure and Practice Problems
- Case Study on Nissan Leaf electric vehicle.
- Safety, Testing, Regulations, and Standards of Electric and Hybrid vehicle's
- Lithium Ion Battery Management Systems

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Describe the operation and overview of Electric vehicle	Apply	1	1, 2, 3, 4, 7
2	Distinguish the EVs	Analyze	1	1, 2, 3, 4, 5, 6
4	Analyze different EVs Communications.	Analyze	2	1, 5, 7, 9
3	Make use of energy storage technologies in EVs.	Create	2	1, 5, 7, 9

TEXT BOOKS:

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2. Hybrid Electric Vehicles – Teresa Donateo, Published by ExLi4EvA, 2017

REFERENCE BOOKS:

1. Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, MehrdadEhsaniYiminGao Stefano Longo Kambiz M. Ebrahimi, Taylor & Francis Group, LLC, 2018.

Image Source: https://www.omazaki.co.id/en/types-of-electric-cars-and-working-principles/

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basic Electrical and Electronics Engineering; Electrical Machines; Power Electronics

COURSE DESCRIPTION AND OBJECTIVES:

Course objective is to learn some of the principal advantages of lithium-ion cells versus standard electrochemical battery cells, what their primary components are, and how they work.

MODULE-1

UNIT-1   **12L+8T+0P=20 Hours**

Energy Storage System Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zine Chloride battery; Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System

UNIT-2   **12L+8T+0P=20 Hours**

Battery Characteristics & Parameters: Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters Heat generation- Battery design- Performance criteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements of batteries- Meeting battery performance criteria- setting new targets for battery performance.

PRACTICES:

- Study and understand types and rating of Battery
- Study of Charging and discharging characteristics
- Comparative Study of Lead acid and Li-ion battery

MODULE-2

UNIT-1:   **12L+8T+0P=20 Hours**

Battery Modelling: General approach to modelling batteries, simulation model of a rechargeable Li-ion battery, simulation model of a rechargeable NiCd battery, Parameterization of the NiCd battery model, Simulation examples.

UNIT-2   **12L+8T+0P=20 Hours**

Battery Pack &Battery Management System: Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests.

PRACTICES:

- Study of Cell balancing algorithm for Lithium-ion Battery
- Study and understand Control parameters of battery

- Compute battery-pack of given energy and power

SKILLS:
- Form factors, Chemistry of Lithium ion Battery, Assembly of Lithium ion battery.
- Lithium ion Battery Cell Modelling. Open circuit voltage.
- various techniques to implement Battery thermal management system
- Design a thermal management system for Electric Vehicles.
- Design a battery pack for given electrical vehicle specifications.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify the types of energy storage system.	Apply	1	1, 2, 3, 4, 7
2	Apply the concepts of battery management system and design the battery pack.	Apply	2	1, 5, 7, 9
3	Describe about the battery characteristic & parameters	Analyze	1	1, 2, 3, 4, 5, 6
4	Model different types of batteries	Create	2	1, 5, 7, 9

TEXT BOOKS:
1. G. Pistoia, J.P. Wiaux, S.P. Wolsky, "Used Battery Collection and Recycling", Elsevier, 2001. (ISBN: 0-444-50562-8)"
2. Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", John Wiley & Sons. 2017. (ISBN: 978-1-1193-2185-9)

REFERENCE BOOKS:
1. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", JohnWiley& Sons Ltd., 2016.
2. Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", Springer, 2018. (ISBN: 978-3-319-70571-2).

ENERGY STORAGE MANAGEMENT SYSTEM
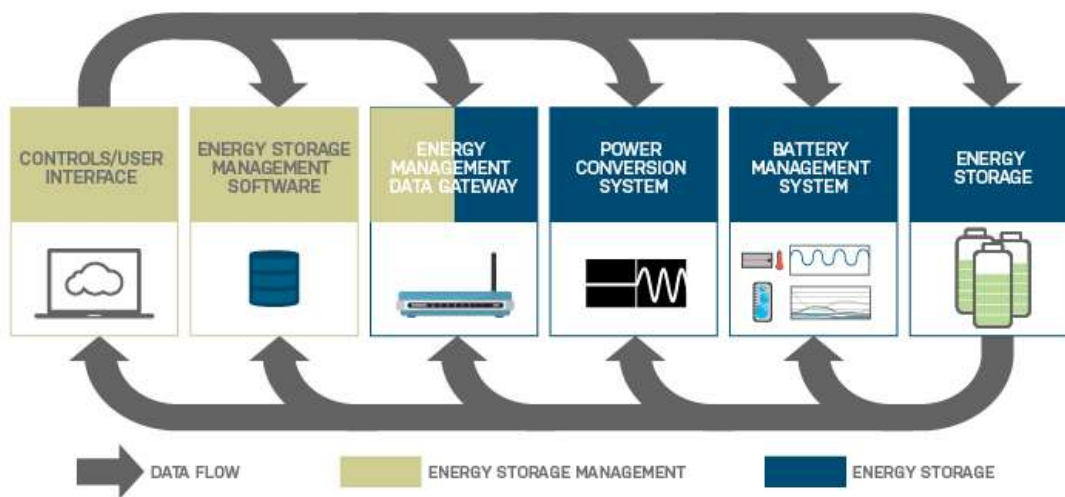
CONTROLS/USER INTERFACE — ENERGY STORAGE MANAGEMENT SOFTWARE — ENERGY MANAGEMENT DATA GATEWAY — POWER CONVERSION SYSTEM — BATTERY MANAGEMENT SYSTEM — ENERGY STORAGE

DATA FLOW   ENERGY STORAGE MANAGEMENT   ENERGY STORAGE

Image Source: https://cleantechnica.com/2015/04/09/us-energy-storage-management-systems-grow-tenfold-2019-gtm/

PREREQUISITE KNOWLEDGE: Basic Electrical and Electronics Engineering; Electrical Machines; Power Electronics

COURSE DESCRIPTION AND OBJECTIVES:

Course objective is to learn various charging techniques and charges are available to charge the battery of EVs and learn about BMS requirements, and the requirements for sensing and high-voltage control in detail.

MODULE-1

UNIT-1   **12L+8T+0P=20 Hours**

Charging Methods: Electric Vehicle Technology and Charging Equipment's - Basic charging Block Diagram of Charger - Difference between Slow charger and fast charger - Slow charger design rating - Fast charger design rating.

UNIT-2   **12L+8T+0P=20 Hours**

Types of Chargers: AC charging and DC charging - On board and off board charger specification - Type of Mode of charger Mode 2, Mode 3 and Mode 4 - EVSE associated charging time calculation - Selection and sizing of fast and slow charger (AC & DC) - AC Pile Charger, DC Pile Charger.

PRACTICES:
- Slow charger design rating
- Fast charger design rating
- EVSE associated charge times calculation

MODULE-2

UNIT-1   **12L+8T+0P=20 Hours**

EVSE Communication: Power Module selection and technical specification - Selection of EVSE Communication Protocol (PLC / Ethernet / Modbus/ CAN Module) - Communication gateway - Specification of open charge point protocol (OCCP 1.6/2.0) - Bharat DC001 & AC001 Charger specification - Communication Interface between charger and CMS (Central Management System) - Payment apps.

UNIT-2   **12L+8T+0P=20 Hours**

Charging Communication: Selection of AC charger type-1, type -2 and type -3 - Communication between AC charger and EV - Selection of DC charger connector GB/T, CHAdeMO, CCS-1 and CSS-2 - Communication methodology of DC fast chargers.

PRACTICES:
- Preparation of EV Charger Single Line Diagram
- Selection of relay and calculation
- Preparation of EV Charger Electric

SKILLS:
➢ Battery management System Design strategies. All the component design for battery management system.
➢ BMS IC Selection techniques.
➢ All the component design for battery management system.
➢ UART, I2C, SPI, CAN Communication Protocols with the C programming and live examples
➢ BMS design for 12V application Battery from scratch

COURSE OUTCOMES:
Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of battery management system and design the battery pack.	Apply	2	1, 5, 7, 9
2	Describe about the types of chargers	Analyze	1	1, 2, 3, 4, 5, 6
3	Model different EV service equipments	Create	2	1, 5, 7, 9
4	Discuss about the different types of charging methods.	Create	1	1, 2, 3, 4, 7

TEXT BOOKS:
1. "Vehicle Inspection Handbook", American Association of Motor Vehicle Administrators.
2. MehrdadEhsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles_ Fundamentals, Theory, and Design, Second Edition", CRC Press, 2010.

REFERENCE BOOK:
1. Amir Khajepour, Saber Fallah and AvestaGoodarzi, "Electric and Hybrid Vehicles Technologies, Modeling and Control: A Mechatronic Approach", John Wiley & Sons Ltd, 2014.

Image Source: https://circuitdigest.com/article/electric-vehicle-on-board-chargers-and-charging-stations
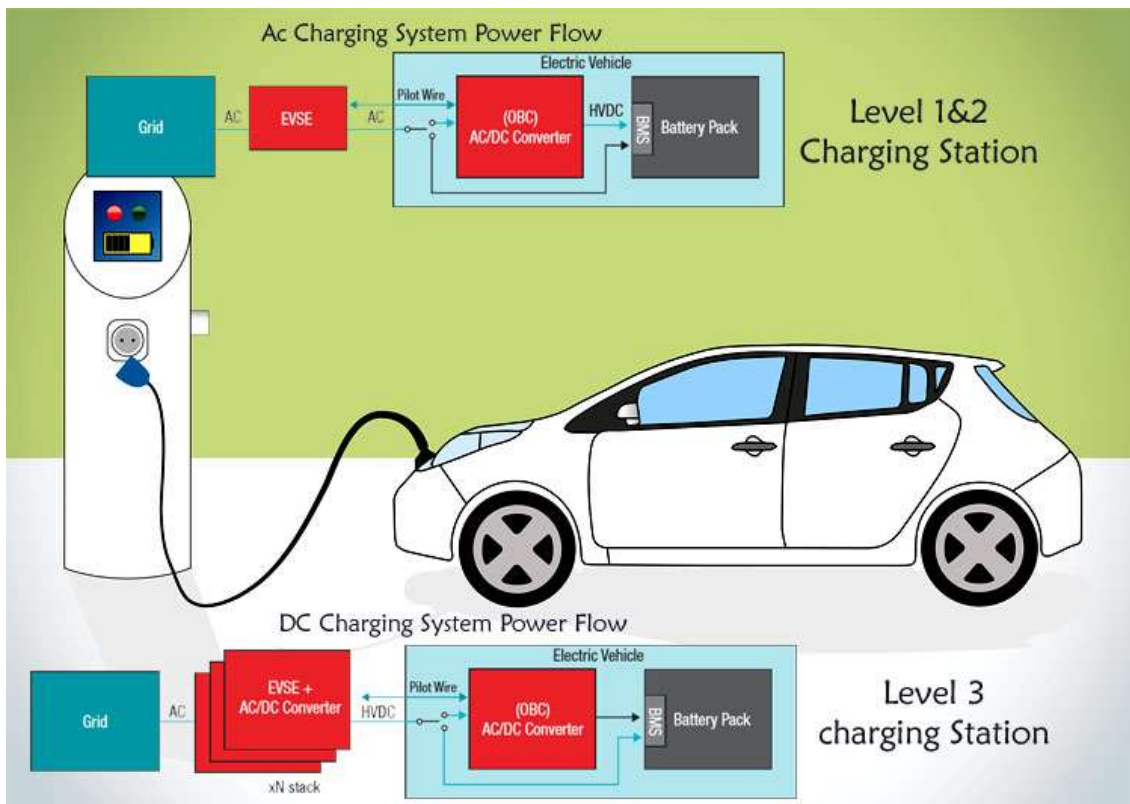
MINOR ON FOOD PROCESSING TECHNOLOGY
Offered by Department of Food Technology

SCOPE:

       Food is an essential part of everyone's lives as it gives us the energy and nutrients to grow and develop, be healthy and active, to move, think and learn. The food you consume on a daily basis is the result of extensive food research, a systematic investigation into a variety of foods, their properties and compositions. The majority of undernourished people live in developing countries like India and the reason is not the lack of food production but the lack of technology for storage and processing of food.

       India ranks first in milk production, second in fruits and vegetables production in the world. However, it's a global share in international market is just 1%. Over the past few years, the demand has been exponentially increasing due to various socio- economic factors such as increased population and income. Within the next 50 years, the world's population is expected to rise to over 9 billion which is alarming and so is the problem of availability of safe food. Food Technology makes it possible for the majority of the world's current population of seven billion to have better access to an abundant, diverse food supply that is largely safe, flavourful, nutritious, convenient and economical than ever before.

BENEFITS:

Principles of Food Processing and Preservation
- To learn basic food preservation techniques, principles and processing methods
- To provide awareness on chemical and natural preservatives in commercially available foods.

Fruits and Vegetables Processing
- To apply the principles and concepts behind fruit and vegetable processing.
- To gain knowledge on managing post - harvest losses during storage and transportation.

Dairy Technology
- To gain knowledge on handling, processing and preservation of milk and milk products.
- To impart knowledge about milk, milk processing methodologies, processing equipment, by-product utilization.

Bakery and Confectionery Technology
- To learn about bakery and confectionery sector of food processing.
- To acquaint the students with preparation methods for various bakery and confectionary products, quality control aspects, processing parameters and handling of equipment.

Food Safety and Quality Management
- To know about the global food safety, security, Food laws, standards and regulations.
- To impart knowledge to students on national and international food standards along with application of ISO and HACCP in food processing industries.

    This minor will enable the students to have deep insights in processing, preservation and quality manufactured food.

Course Code	Course Title	L	T	P	C
22FT901	Bakery and Confectionery Technology	3	0	2	4
22FT902	Dairy Technology	3	0	2	4
22FT903	Food Safety and Quality Management	2	2	0	4
22FT904	Fruits and Vegetables Processing	3	0	2	4
22FT905	Principles of Food Preservation and Processing	3	0	2	4

22FT901-BAKERY AND CONFECTIONARY TECHNOLOGY

Hours per Week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Cereal Processing

COURSE DESCRIPTION AND OBJECTIVES:
This course deals with bakery and confectionery sector of food processing. The objective of this course is to acquaint the students with preparation methods for various bakery and confectionary products, quality control aspects, processing parameters and handling of equipment.

MODULE-1

UNIT-1   **18L+0T+0P=18 Hours**
BASIC CONCEPT OF BAKERY:
Global and Indian status of bakery and confectionary industry; Ingredients and their role in bakery industry (wheat flour, sugar, fat and oils, egg, yeast, salt, leavening agents, moistening agent, improvers and emulsifiers); Types of dough developed - developed dough, short dough, semi-sweet, enzyme modified dough; Importance of the consistency of the dough (straight dough, rapid processing, mechanical dough);
Breads: Ingredients and process flow of preparation; Types of breads; Various faults in breads – staling of bread, losses during manufacturing; Equipment's used - make up equipment; Functions of mixing and mixer type (horizontal, vertical, planetary and continuous mixers) and blenders used in bakery industry; Divider; Rounder; Moulder; Proofer; Oven; Slicer and packaging materials used;
Biscuits and Cookies: Process flow and manufacturing; Biscuits-ingredients and flour specifications; Process flow manufacturing; Types of biscuits and crackers; Faults in biscuits.

UNIT-2   **6L+0T+16P=22 Hours**
ANALYSIS OF BAKERY PRODUCTS:
Physicochemical parameters of bakery ingredients; Rheological testing of dough; Effect of process parameters on quality-biscuit and cookies; Packaging material for biscuits; Gluten free products and pasta - raw material, processing and quality parameters.

PRACTICES:
- Gluten determination of cereal flour.
- Determination of dough raising capacity.
- Water absorption index and solubility test of flour sample.
- Process flow sheet of breads Analysis of quality parameters of developed bread (textural properties, sensory analysis).
- Process flow for different types of biscuits, cookies and crackers.
- Analysis of quality parameters of developed biscuits and cookies (fat, textural properties, sensory analysis).

MODULE-2

UNIT-1   **15L+0T+0P=15 Hours**
CAKE AND CONFECTIONARY PRODUCTS:
Cakes: Ingredients; Flour specification; Process flow and quality evaluation; Faults and corrective measures;
Confectionary - Raw materials used in confectionery; Chocolate processing;

Miscellaneous products - Co-extruded products; Bakery plant layout; Safe practices in work-place sanitation; Code for hygienic conditions.

UNIT-2   **9L+0T+16P=25 Hours**
PREPARATION AND PROCESSING OF DIFFERENT CONFECTIONARY PRODUCTS:
Sugar confectionery: Processing and quality assessment of cotton candy, fruit drops, centre filled toffees, caramel; lollipops; chewing gums and bubble gums; Preparation and analysis of fudges, lozenges toffees, marshmallow and fondants, 3 D food printing.

PRACTICES:
- Preparation and quality analysis of cakes, pastries, doughnuts, Pizza.
- Processing and analysis of chocolate and candy bars.
- Preparation and quality analysis of cakes, doughnuts, Pizza.
- Preparation and analysis of hard-boiled candies, centre filled toffees, caramel.
- 3D printing of confectionery products

SKILLS:
- Prepare commonly consumed bakery products like bread and fermented foods,
- Cookies, biscuits, cakes and Icing.
- Judge the quality of raw-materials.
- Predict the physiochemical changes during processing.
- Handling of various bakery equipment.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify various ingredients used in bakery and confectionary products	Apply	1	1, 3, 4, 5, 9, 10, 12
2	Analyse the function and interaction of carbohydrate and protein during dough development.	Analyze	1, 2	1, 2, 9, 10
3	Analyse the nutritional properties of value-added bakery and confectionary products.	Analyze	1,2	1, 2, 3, 5, 9, 10
4	Evaluate the impact of processing methods on quality of baked and confectionary products.	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12
5	Develop suitable method for value added bakery product development.	Create	2	1, 2, 4, 9, 10, 12

TEXT BOOKS:
1. W. J. Sultan, "Baker's Handbook on Practical Baking", 5th edition, US wheat Associates, Wiley, 2010.
2. J. Kingslee, "A Professional Textto Bakery and Confectionery", 3rd edition, New Age International, New Delhi, 2006.

REFERENCE BOOKS:

1. E. B. Jackson, "Sugar Confectionery Manufacture", 2nd edition, Springer, 1995.
2. Ashok kumar Y, "Textbook of Bakery and Confectionery: Second Edition", 2nd edition, Prentice Hall India Learning Private Limited, 2012.
3. Geoff Talbot, "Science and Technology of Enrobed and Filled Chocolate, Confectionery and Bakery Products", Woodhead Publishing Series in Food Science, Technology and Nutrition, 2009.

Image source: https://www.bizbuysell.com/bakeries-for-sale/3/

Image file name: Bakery and confectionery Technology

22FT902 – DAIRY TECHNOLOGY

Hours per Week:			
L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Microbiology, Food Biochemistry.

COURSE DESCRIPTION AND OBJECTIVES:
This course deals with handling, processing and preservation of milk and milk products. The objective of this course is to impart knowledge about milk, milk processing methodologies, processing equipment, by-product utilization and to bestow skills.

MODULE-1
UNIT-1   **18L+0T+0P=18 Hours**
MILK, CREAM AND BUTTER:
Milk: Basics properties of milk - milk, composition; Pre-processing of milk - buying and collection of milk, cooling and transportation of milk, receiving, preheating, filtration/ clarification, cooling, storage of raw milk; Pasteurization - definition, objectives, methods of pasteurization, homogenization, different liquid Milk-Standard, toned, double toned etc. sterilized milk and UHT, bottling, and storage.
Cream: Definition; Classification; Composition; Factors affecting fat percentage of cream; Defects in cream - causes and prevention.
Butter: Definition: Classification; Composition; Method of manufacture; Packaging and storage of butter; Butter over run; Theories of churning; Continuous butter making; Defects in butter-causes and prevention.

UNIT-2   **6L+0T+16P=22 Hours**
PRACTICAL AND INDUSTRIAL APPLICATION OF MILK PRODUCTS:
Physico-chemical properties of milk; Standardization of milk; Platform test for milk; CIP methods; Detection of common adulterants present in milk; Cream production; Preparation of Butter oil from milk and butter.

PRACTICES:
- Physico-chemical properties of milk.
- Standardization of milk.
- CIP methods.
- Platform test for milk.
- Detection of common adulterants present in milk
- Preparation of Butter oil.

MODULE-2
UNIT-1   **15L+0T+0P=15 Hours**
CHEESE, ICE CREAM AND INDIGENOUS MILK PRODUCTS:
Cheese: Method of manufacture; Types of Cheese: Curing of cheese; Defects in cheese -causes and prevention; Whey processing
Dehydrated milk products- WMP, SMP, Infant Milk powders, Malted Milk Foods.
Fermented milk: Starter culture – types, propagation and defects.
Indigenous milk products: Khoa: Chhana; Paneer; Shrikhand. Ghee

Ice Cream: Definition; Classification; Composition; Nutritive value; Role of constituents in ice cream; Ice-cream Vs Frozen desserts; Method of manufacture; Packaging; Hardening and storage; Over run-in ice cream; Defects - causes and prevention

By-products of dairy industry: Processing of by-products – whey, WPC, WPI, buttermilk, ghee residue; Processing of casein and lactose.

UNIT-2:   **9L+0T+16P=25 Hours**
RULES AND REGULATION IN DAIRY PRODUCTS AND INDUSTRY:
Preparation and analysis of dairy products-FSSAI standards

PRACTICES:
- Preparation of yoghurt and curd.
- Preparation and analysis of natural butter milk, cultured butter milk, acidophilus milk, bulgarian butter milk, kumis, kefir.
- Preparation of Special milk - flavoured, chocolate, vitaminized/irradiated, and concentrated.
- Preparation of Channa based sweet & Paneer.
- Preparation of Khoa based sweets.
- Preparation of Ice cream.
- Preparation of milk powder by spray drying method.

SKILLS:
- Determine physico-chemical properties of milk.
- Perform Standardization of milk for different products.
- Proficiency on processing and manufacturing methods of milk and dairy products.
- Identify the milk processing equipment required for a specific application.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of separation techniques for production of cream, butter, cheese, ice cream.	Apply	1, 2	1, 2, 5, 9, 10
2	Analyse the composition of milk and identify various processing methods of milk.	Analyze	1,2	1, 2, 4, 5, 9, 10, 12
3	Analyse the nutritional properties of dairy products.	Analyze	2	1, 2, 3, 5, 9,
4	Evaluate the properties of various indigenous milk products	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12
5	Development of fermented and unfermented dairy-based beverages and specialty products.	Create	2	1, 2, 5, 9, 10, 12

TEXT BOOKS:
1. S. De, "Outlines of Dairy Technology", 1st edition, Oxford University Press, 2019.
2. J. N. Warner, "Principles of Dairy Processing", 3rd edition, Wiley Eastern Ltd., Delhi, India, 2018.

REFERENCE BOOKS:

1. K. S. Bangarappa and K. L. Acharya, "Indian Dairy Products", 2nd edition, Asia Publishing House, Bombay,1974.
2. P. Walstra, "Dairy Science and Technology", 2nd edition, Taylor & Francis, 2006.
3. Pieter Walstra, "Dairy Technology: Principles of Milk Properties and Processes", CRC Press, 1999.

Image source: https://www.motherdairy.com/
Image file name: Dairy Technology

22FT903- FOOD SAFETY AND QUALITY MANAGEMENT

Hours per Week:

L	T	P	C
3	2	0	**4**

PREREQUISITE KNOWLEDGE: Food Quality, Food Microbiology, Food Toxicology

COURSE DESCRIPTION AND OBJECTIVES:
The course deals with global food safety, security, Food laws, standards and regulations. The objective of this course is to impart knowledge to students on national and international food standards along with application of ISO and HACCP in food processing industries.

MODULE-1

UNIT-1   **18L+6T+0P=24 Hours**
FOOD SAFETY AND NATIONAL FOOD LAWS:
Food Quality: Quality attributes of food, Gustation: Mechanism of taste perception, Difference tests for sensory evaluation; Olfaction, Colour: CIE (International Commission on Illumination) color system; Image processing techniques for Food Quality Evaluation; Texture. Introduction to food safety& standards, Concept of food Hazards- Physical, Chemical and biological, Food adulteration and safety, Permitted Food additives and limits, Statistical Quality Control techniques.

UNIT-2   **6L+10T+0P=16 Hours**
INDIAN STANDARDS:
FSSAI-law, structure, working and powers, AGMARK act and rules- Certification procedure, laboratory approvals and actions on non-compliance, appeals, BIS- scope, definition, power and functions of BIS, Licensing procedure, export and import laws and regulations, Export (Quality and inspection) act 1963; APEDA& MPEDA- introduction, act and rules, functions and products monitored.

PRACTICES:
- Case study on food quality standards
- Finding hazards in food product samples: Biological hazards, Chemical hazards, Physical hazards, Trace chemicals.
- Case study on microbiological considerations in food safety.
- HACCP: Identification of CCPs, application of HACCP in food industry.
- Case study on APEDA & MPEFA

MODULE-2

UNIT-1   **12L+2T+0P=14 Hours**
INTERNATIONAL FOOD LAWS:
FAO: Overview of Organization structure, Objectives & Functions; Introduction to WHO; Codex Alimentarius commission - role of CAC and its committees; Introduction to OIE and IPPC; Introduction of other international food standards- BRC, Kosher etc. WTO - introduction to WTO agreements, SPS and TBT Agreement; Implications on trade in light of SPS and TBT.

UNIT-2   **12L+14T+0P=26 Hours**

QUALITY MANAGEMENT AND QUALITY ASSURANCE:
Total quality management, Good manufacturing practices, good agricultural practices, good laboratory practices; Quality management systems, QSS; Quality circles, SQC; ISO system.
HACCP: Principles, implementation; Plan documentation, types of records; Auditing: Surveillance, audit, mock audit, third party quality certifying audit, auditors and lead auditors; Certification, certification procedures, certifying bodies, accrediting bodies, international bodies.

PRACTICES:
- Case study on quality management
- Introduction to Contents of the standards, Salient features, Advantages of implementation of the standard, Certification & Auditing;
- ISO 9001:2008 - evolution of ISO 9001:2008, Introduction to the family of ISO 22000 standards - FSMS – 22000:2005, various elements and clauses included in the standard;
- Comparison of ISO 9001:2008 vs. ISO 22000:2005.
- Implementation of HACCP in any food company.

SKILLS:
- Apply different coloring matter in developing new food products.
- Preserve food in a synergistic manner using chelating and antioxidants.
- Make use of different thickening agents in modifying the food texture.
- Develop different variety of food products using different flavor on same basic ingredient.
- Determine toxicity level of each food additive.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of food safety protocols to food business operators.	Apply	2	1, 2, 3, 4, 6, 7, 8, 9
2	Analyze and identify the food hazards and risk associated with it.	Analyze	1	1, 2, 4, 6, 7
3	Analyze knowledge of naturally available food additive for food preservation.	Analyze	1	1, 2, 3, 4, 5, 6, 8,12
4	Analyze and identify various food additives and their safe usage limits.	Analyze	1, 2	1, 2, 5, 7, 9, 10, 11, 12
5	Formulate the optimal level of food additives for various food applications.	Create	2	1, 2, 5, 9, 10, 12

TEXT BOOKS:
1. C. A. Roberts, "The Food Safety Information Handbook", 2nd edition, Oryx Press, 2001.
2. R. H. Schmidt and G. E. Rodrick, "Food Safety Handbook", 3rd edition, John Wiley & Sons, 2005.

REFERENCE BOOKS:

1. N. Rees and D. Watson, "International standards for food safety", 1st edition, Aspen publishers, Gaithersburg, Maryland. 2000.
2. P. L. Knechtges, "Food safety: Theory and Practice", 1st edition, Jones and Bartlett learning, UK, 2012.

Image source: https://www.kizytracking.com/fssc-22000-compliance-food-safety-standards/

Image file name: Food Safety and Quality Management

22FT904- FRUITS AND VEGETABLES PROCESSING

Hours per Week:

L	T	P	C
3	0	2	**4**

PREREQUISITE KNOWLEDGE: Food preservation methods.

COURSE DESCRIPTION AND OBJECTIVES:
This course deals with technologies related to handling, processing and storage of fruits and vegetables. Impart skill and knowledge required to apply the principles and concepts behind fruit and vegetable processing including post-harvest handling.

MODULE-1
UNIT-1   20L+0T+0P=20 Hours
INTRODUCTION TO FOOD PRESERVATION TECHNIQUES:
Current status of production and processing of fruits and vegetables; Chemical composition; Pre and postharvest changes; Role of plant growth regulators in relation to storage; Maturity standards for storage, and desirable characteristics of fruits and vegetables for processing; Conditions for transportation and storage; Post-harvest physiology.

UNIT-2   4L+0T+16P=20 Hours
APPLICATION OF FOOD PRESERVATION:
Fruit Beverages: juice, pulp, RTS, squash, nectar, cordial, syrup, and extract),
Jam, jelly, marmalade: Pectin- structure, properties and role; Determination of end point; Defects in Jam, jelly Marmalade;
Canning: Blanching and bottling (oven dry pack, oven wet pack, slow water bath, fast water bath and pressure bottling), retorting.

PRACTICES:
- Determination of quality parameters of different fruits and vegetables processed products.
- Determination of sugar acid ratio in fruits and vegetables.
- Determination of pectin content in fruits and vegetables.
- Preparation of jam and determination of TSS and viscosity. (FSSAI Standards)
- Preparation of jelly and marmalade and determination of TSS and viscosity. (FSSAI Standards).
- Testing the adequacy of blanching.
- Clarification of juices with enzymes.

MODULE-2
UNIT-1   20L+0T+0P=20 Hours
MINIMAL PROCESSING OF FRUITS AND VEGETABLES:
Minimally processed fruits and vegetables: Factors affecting shelf life and the quality of minimally processed fruits and vegetables; Physiology and biochemistry of fresh cut; Preservation by freezing - general methods for freezing of fruits and vegetables, problem relating to storage of

frozen products, standards for frozen fruits and vegetables; Dehydration of fruits and vegetables – methods of drying; Packaging (CA and MA storage).

UNIT-2   **4L+0T+16P=20 Hours**
FERMENTED FRUITS AND VEGETABLE PRODUCTS:
Fermented fruits and vegetable products: Vinegar - production, its uses and quality control checks.
Pickle and chutney processing: Role of lactic acid bacteria in pickling with vinegar and fermentation, sauerkraut, kimchi.

PRACTICES:
- Determination of colour values (L, A, B, ΔE, Chroma & Hue) for food sample.
- Preparation of pickles, chutneys and their quality and cost evaluation.
- Textural properties analysis using penetrometer.
- Preparation of tomato products and their quality and cost evaluation.
- Determination of viscosity of fruit based products.
- Preparation of fruit leather and its quality and cost evaluation.
- Determination of total phenolic content and antioxidant activity by DPPH method.
- Wine and alcoholic beverage preparation.

SKILLS:
➢ Specify physiological, physical, chemical and nutritional properties of fruits and vegetables.
➢ Identify the post-harvest factors that effect on shelf life of fruits and vegetables.
➢ Suggest suitable processing and storage conditions for fruit and vegetable products.

COURSE OUTCOMES:
Upon completion of the course, the student will be able to achieve the following outcomes:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge on processing of fruits and vegetables.	Apply	1,2	1,2,3,4
2	Apply the knowledge of canning for preservation of fruit and vegetable products.	Apply	1	1,2,8,6
3	Identify the factors affecting the shelf life of minimally processed foods.	Analyse	2	2,3,4,8
4	Develop fermented fruits and vegetable food products.	Create	1,2	3,4,5,7,
5	Develop the preservation techniques to improve the shelf life of seasonal fruits.	Create	1	1,2,3,4,5, 7

TEXT BOOKS:
1. R. P. Srivastava and S. Kumar, "Fruit and Vegetable Preservation - Principles and Practices", 6th edition, International Book Distributors, 2003.
2. G. Lal, G. S. Siddappa and G. L. Tandon, "Preservation of Fruits and Vegetables", 3rd edition. ICAR, New Delhi, 1998.

REFERENCE BOOKS:
1. H. Ramaswamy and M. Marcotte, "Food Processing: Principles and Applications" Hardcover, Import, 2005.
2. Rachna Sehrawat, Khursheed A. Khan, Megh R. Goyal and Prodyut K. Paul, "Technological Interventions in the Processing of Fruits and Vegetables" 1st edition, Apple Academic Press, 2018.

Image source: https://nuffoodsspectrum.in/2022/01/10/foodtech-pathshala-announces-virtual-factory-visit.html
Image file name: Fruits and Vegetables Processing

22FT905- PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

Hours per Week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of food preservation, classification, application, advantages and limitations.

COURSE DESCRIPTION AND OBJECTIVES:
This course deals with the basic principles involved in food preservation methods. The objective of this course is to provide students with the knowledge of basic food preservation principles and processing methods to control food spoilage and deterioration.

MODULE-1

UNIT-1   **20L+0T+0P=20 Hours**
INTRODUCTION TO FOOD PRESERVATION TECHNIQUES:
History, Scope and principles of food preservation; Preservation Methods- preservation by low temperature- processing, mechanism, refrigeration, chilling, freezing, freezing curve, changes occurring during freezing, types of freezing, thawing, and its effects.
Preservation by high temperature: Different thermal operations-sterilization, pasteurization, blanching, and UHT processing; Canning- different unit operations involved, canning equipment, types of canning containers; Thermal destruction of Microorganisms – D value, F- value, Z-value.
Chemical food preservation: Types of chemical preservatives used to preserve the food and its functions; Permissible limits and safety aspects of using chemical preservatives.

UNIT-2   **4L+0T+16P=20 Hours**
APPLICATION OF FOOD PRESERVATION:
Applications of traditional food preservation techniques, Food preservation by pasteurization, Autoclaving, Blanching, addition of preservatives.

PRACTICES:
- To study the Physico-chemical properties of refrigerated and frozen foods.
- Study on importance and principles of food pasteurization.
- Study on importance and principles of food autoclaving.
- Study on importance and principles of food blanching.
- To understand role of sodium benzoate and potassium sorbate in preserving beverages.
- Case studies on thermal destruction of microorganisms: D, F and Z- value.

MODULE-2

UNIT-1   **20L+0T+0P=20Hours**
NOVEL FOOD PRESERVATION TECHNIQUES:
Novel food processing techniques: Irradiation, microwave, radio-frequency, high-pressure processing, pulsed electric field, hurdle technology, ohmic heating, membrane processing, cold plasma.

UNIT-2   **4L+0T+16P=20Hours**
APPLICATION OF NOVEL FOOD PRESERVATION TECHNIQUES:
Application of novel food processing techniques in food preservation; Food preservation by additives.

PRACTICES:
- Application of thermo-sonication in food preservation.
- Study the importance and principles of membrane processing.
- Application of microwave heating in food preservation.
- Study the importance and principle of hurdle technology in food preservation.
- Application of ohmic heating in food preservation.
- Preservation of food by using additives.

SKILLS:
➢ Identify appropriate processing and preservation method for a given food.
➢ Identify and suggest suitable food additive for a given food product.
➢ Troubleshoot problems related to food safety during food processing.

COURSE OUTCOMES:
Upon completion of the course, the student will be able to achieve the following outcomes:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various physical, chemical and biological methods of food preservation to extend shelf life of food.	Apply	1,2	1,2,3,4
2	Apply the knowledge of various non-thermal processing techniques for food preservation.	Apply	1,2	1,2,4,5,7
3	Identify chemical preservatives and their safe usage limit.	Analyze	1,2	4,5,7
4	Investigate the impact of various types of thermal processing on food preservation and analyse thermal sterilization kinetics.	Analyze	1	1,2,8
5	Formulate thermal process conditions to attain sterility and ensure safe food.	Create	1	2,3,4,8
6	Use the principle of low-temperature preservation to create new methods to reduce food spoilage.	Create	1	1,2,3,4,5

TEXTBOOKS:
1. Physical Principles of Food Preservation: Revised and Expanded, 2nd edition, Marcus Karel, Daryl B. Lund, 2008.
2. J. P. Fellows, "Food Processing Technology, Principles and Practices", 2nd edition, Wood Head Publishing, 1999. 3. N. N. Potter and J. H. Hotchkiss, "Food Science," 5th edition, Springer, 1998.

REFERENCE BOOKS:
1. H. Ramaswamy and M. Marcotte, "Food Processing: Principles and Applications" Hardcover, Import, 2005.

2. B. Lal, G. B. Siddappa and G. N. Tandon, "Preservation of Fruits and Vegetables," 2 nd edition, ICAR Publication, 1967.
3. Potter N. N. and Hotchkiss J. H., "Food Science" 5th e-book edition, CBS Publishers & Distributors Pvt. Ltd. 2021.

Image source: https://greentumble.com/how-to-preserve-food-for-years/
Image file name: Principles of Food Processing and Preservation

MINOR ON CYBER LAW, IPR AND CONSTITUTIONAL LAWS
Offered by Vingnan Institute of Law

Cyber law, IPR and Constitutional laws are an integral part of the overall legal system, which deals with the legal issues of cyber space, Intellectual Property Rights and other Constitutional Law matters. Cyber law is also referred to as the Law of the Internet. Cyber laws help businesses to prevent any kind of identities and data theft, privacy violation and fraud. Cyber Laws yield legal recognition to electronic documents and a structure to support e-filing and e-commerce transactions and also provides a legal structure to reduce, check cyber crimes. It covers all transactions over the internet. In addition to this, strong and enforced Intellectual Property Rights (IPR) protects consumers and families. Strong IP rights help consumers make an educated choice about the safety, reliability and effectiveness of their purchases. Enforced IP rights ensure products are authentic, and of the high-quality that consumers recognize and expect. Intellectual Properties (IP) include patents or inventions, trademarks, trade names, biodiversity, plant breeding rights and other commercial interests. A patent gives its holder the exclusive right to use the Intellectual Property (IP) for the purposes of making money from the invention. Intellectual Property Rights (IPR) Awareness is critical to shaping an environment that is conducive to fostering creativity & innovation in the country. One of the key focus areas is children in schools, as it is essential to nurture creativity and the ability to innovate from a young age. Lastly, students who understand the Constitution are in a better place to challenge Governments that create unjust laws with the purpose of consolidating power, rather than to govern justly. Constitutional Law creates a National Government consisting of a legislative, an executive, and a judicial branch, with a system of checks and balances among the three branches. Further, it divides power between the federal government and the states. Thereafter, it protects various individual liberties of all citizens or subjects. Constitutional law sets the basic framework for Governmental powers, civil rights and civil liberties. Statutes are enacted by elected legislatures, to set out provisions to establish Administrative rules, regulations and policies etc.

Choosing this minor helps the students to understand the concepts of legal aspects that may come up in their profession practice as engineers.

Course Code	Course Title	L	T	P	C
22LW901	Constitutional Law	4	0	0	4
22LW902	Copy Right, Trademark & Design Law	4	0	0	4
22LW903	Cyber Security & Information Technology Laws	3	0	2	4
22LW904	Patent Act & Technology Transfer Laws	4	0	0	4
22LW905	Right to Information Act	4	0	0	4

22LW901-CONSTITUTIONAL LAW

Hours per week:

L	T	P	C
4	0	0	4

PREREQUISITE KNOWLEDGE: Introduction to Legal System in India

COURSE DESCRIPTION & OBJECTIVES:
Constitution, the grund norm of all laws comprises various facets like federalism, fundamental rights, Centre-State relations etc. In a democratic nation like India, the law students need to know thoroughly the various aspects of constitution to become a complete legal professional. This Course mainly covers the principles of federalism, fundamental rights, constitutional remedies and emphasis has would be laid on directive principles of state policy and fundamental duties

MODULE-1

UNIT-1   **10L+0T+0P=10 Hours**
INTRODUCTION TO CONSTITUTIONAL LAW OF INDIA:
Constitution – Fundamental Law of the Land: Making of the Indian Constitution, Aims and Objectives; Essential Features of Constitution; Theory of Basic Structure; Principles of Federalism; Nature of the Indian Constitution – Federal, Unitary, Quasi-federal; Union and State Territory; Citizenship; Definition of State, Doctrines of Ultra-vires, severability, eclipse, waiver'; Parliament's power to amend the Constitution

UNIT-2   **10L+0T+0P=10 Hours**
FUNDAMENTAL RIGHTS:
Judicial Review, Right to Equality, Prohibition on grounds of Religion, Race, Caste, Sex, Place of Birth, Equality of Opportunity in Public Employment, Abolition of Untouchability and Titles

MODULE-2

UNIT-1   **10L+0T+0P=10 Hours**
FREEDOMS UNDER CONSTITUTION:
Basic Freedoms-Freedom of Speech and Expression Reasonable restrictions; Protection in respect of conviction for offences-Ex-post-facto law, Double jeopardy, Self-incrimination; Right to Life and Personal Liberty, Safeguards against arbitrary arrest and detention

UNIT-2   **10L+0T+0P=10 Hours**
FUNDAMENTAL RIGHTS AND CONSTITUTIONAL REMEDY:
Right against exploitation, Freedom of Religion, Cultural and Educational Rights of Minorities, Constitutional Remedies-Enforcement of Fundamental Right, Writ Jurisdiction of the Supreme Court and High Court, Directive Principles of State Policy and their relation with Fundamental Rights, Fundamental Duties, Right to Property-before and after the Constitution 42nd Amendment Act, 1976;

COURSE OUTCOMES:
Upon Successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	To understand the basics and essential feature of Indian Constitution	Analyse	1	1,2,3,4,5,7
2	To understand the principles of federalism and its application to the India	Analyse	1	1,2,3,4,5,7
3	To appraise and critique the application of fundamental rights through various judicial decisions.	Analyse	2	1,2,3,4,5,7
4	To analyse the significance of Directive Principles of State Policy and Fundamental Duties	Analyse	2	1,2,3,4,5,7
5	To analyse the diverse judicial interpretation of Constitution by Supreme Court and High Courts.	Analyse	2	1,2,3,4,5,7

TEXT BOOKS:
1. M.P Jain: Indian Constitutional Law, Wadhwa & Co., Nagpur.
2. J. N. Pandey, Constitutional Law, Indian Law House

REFERENCE BOOKS:
1. V.N Shukla: Constitution of India, Eastern Books Company, Lucknow.
2. D. D. Basu: Constitutional Law of India; Lexis Nexis Publication
3. H. M. Seervai, Constitutional Law of India, Universal Books, Lucknow

PREREQUISITE KNOWLEDGE: Introduction to Legal System in India

COURSE DESCRIPTION & OBJECTIVES:
Innovations in diverse areas of technology have led to the growth of importance of Intellectual Property Laws. This course aims to give an overview of the evolution of IPR and different types of IPR such as Trademark and Design. The paper is aimed at discussing the jurisprudence of Trademark and Design as emerging areas of IP and judicial decisions on different forms of IP.

MODULE-1

UNIT-1   10L+0T+0P=10 Hours
PROTECTION OF COPYRIGHT:
Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings, Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright, Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights

UNIT-2   10L+0T+0P=10 Hours
PROTECTION OF TRADEMARK:
Trademarks, Evolution of Trademark in India, Justification, International Treaties: Paris Convention, Madrid Agreement and Protocol, NICE Agreement, Trademark Law Treaty, Singapore Law Treaty, TRIPS, Kinds of Trademarks: Registered and Unregistered Trademarks, Conventional & Non-Conventional Trademarks, Service Mark, Collective Marks, Certification Marks, Well Known Trademarks Registration of Trademarks, Pre-requisites, Absolute and Relative Grounds for Refusal of Registration, Concept of Deceptive Similarity and its Applicability in Registration, Procedure for Registration, National and International Registration, Commercial Exploitation of Trademarks and IPAB,

MODULE-2

UNIT-1   10L+0T+0P=10 Hours
PROTECTION OF INDUSTRIAL DESIGNS:
 Rights of Proprietor, Assignment, Licensing and Transmission of Trademark, IPAB, Penalties for infringement, Infringement and Passing off, Infringement, Goodwill and Passing off, Remedies, Trademark Issues in Cyberspace, Industrial Designs, Introduction, Evolution, Justification, International Treaties, Paris Convention, Hague Agreement, Locarno Agreement, TRIPS, Industrial Design Act, 2000, Interface between Design, Copyrights and Trademarks

UNIT-2   10L+0T+0P=10 Hours
INTERNATIONAL IP LAWS REGIME:
Semiconductor and Layout Designs, Introduction, Evolution, Justification, International Treaties: Washington Treaty, TRIPS, The Semiconductor Integrated Circuits Layout-Designs Act, 2000, Penalties for infringement

COURSE OUTCOMES:

Upon Successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	To understand the jurisprudential and theoretical ideology behind the concepts of Trademark and Design Laws	Analyse	1	1,2,3,4,6,9
2	To recognise the economic importance of Trademark and Designs	Analyse	1	1,2,3,4,6,9
3	To understand the origin and development of IPRs and acquaint with various international conventions relating to IPR	Analyse	1	1,2,3,4,6,9
4	To analyse various forms of IP and its interface with technological developments	Analyse	2	1,2,3,4,6,9
5	To interpret and analyse various judicial decisions concerning Trademark and Designs.	Analyse	2	1,2,3,4,6,9

TEXT BOOKS:

   1. K C Kailasam and Ramu Vedaraman, Law of Trademarks including International Registration under Madrid Protocol and Geographical Indications, Lexis Nexis, 2013
2. A. K. Bansal, Law of Trademark in India, Thomson & Reuter, 2014

REFERENCE BOOKS:

1. Tapan Kumar (Ed.), WTO, TRIPS and GIs, New Century Publications, 2014
2. Dev Gangjee, Relocating the Law of GI, Cambridge University Press, 2012
3. K C Kailasam and Ramu Vedaraman, Law of Trademarks including International Registration under Madrid Protocol and Geographical Indications, Lexis Nexis, 2013

22LW903-CYBER SECURITY AND INFORMATION TECHNOLOGY LAWS

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Introduction to Legal System in India

COURSE DESCRIPTION & OBJECTIVES:
With rapid development in information technologies, broadening of cyber space, most of the tasks that humans do have become easy due to developing Internet of Things. On the other hand, it has also brought us various challenges to cyber security and safety. The main objective of this Course is to discuss about various technological law and policy issues covering wide aspects of cyber laws and cyber security.

MODULE- 1
UNIT-1   **9L+0T+6P=15 Hours**
INTRODUCTION TO CYBER SPACE AND IT ACT 2000:
Introduction to cyber space, information technology, cyber security, regulations in cyber space, jurisdiction issues in cyber space, interface of information technology, IoT and Cyber security, Cyber security and law, Introduction to Information Technology Act, 2000

UNIT-2   **9L+0T+6P=15 Hours**
CYBER SECURITY:
Understanding cyber security in cyber space, Cyber Security Vulnerabilities and Cyber Security Safeguards, Choosing safe browsers for email security, Guidelines for securing password and Wi-Fi security, Guidelines for social media and basic Windows security, Guidelines for Smartphone security, Online Banking, Credit Card and UPI Security, Micro ATM, e-wallet and POS Security

MODULE-2

UNIT-1   **10L+0T+0P=10 Hours**
CYBER CRIMES:
Cyber Threats: Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, Censorship, Indecency, Pornography, cyber stalking, phishing, dissemination of obscene material, defamation, hacking/cracking, morphing etc., Cyber Security Regulations & cooperation at Global level, RuNet Law, New York Cyber Security Regulations, California Internet of Things Cyber Security Law, European Cyber Security Framework, Chinese regulatory approach on cyber security, Cyber Security Initiatives in India, National Cyber Security Policy 2013

UNIT-2   **10L+0T+0P=10 Hours**
E-GOVERNANCE:
Information Technology Act, 2000, Digital Signature, E-governance, Regulation of Certifying Authorities, Offences, Penalties, Compensation and Adjudication, Intermediary liability, Electronic evidence and its relevance under Indian Evidence Act, 1872, UNCITRAL Model Law, Cyber Forensics

COURSE OUTCOMES:
Upon Successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	To understand the scope and nature of cyber space and activities happening in cyber space	Analyse	1	1,2,3,4,7,9
2	To analyse various cyber security vulnerabilities and safeguards	Analyse	1	1,2,3,4,7,9
3	To analyse global legal development in terms of cyber security	Analyse	2	1,2,3,4,7,9
4	To identify and differentiate various types of cyber-crimes and other activities	Analyse	2	1,2,3,4,7,9
5	To interpret and analyse Information Technology Act, 2000 with the help of various provisions and judicial decisions	Analyse	2	1,2,3,4,7,9

TEXT BOOKS:
1. Justice Yatindra Singh, Cyber Laws, 6th Edition, Universal Publishing, 2016
2. Pavan Duggal, Cyber Law, 2nd Edition, Universal Publishing, 2017

REFERENCE BOOKS:
1. Sunit Belapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India, 2011.
2. K. K. Sinha, Cyber Crimes and Cyber Security, Nagpur, 2018
3. Kulbhsuhan Khurana, Cyber Security and law, India Law House, 2011

Hours per week:

L	T	P	C
4	0	0	4

PREREQUISITE KNOWLEDGE: Introduction to Legal System in India

COURSE DESCRIPTION & OBJECTIVES:
This course is developed to an extent to assist human intelligence through its enhanced cognitive skills in filing and protecting the Patents for future ready solutions in many areas like Science, Technology, health care, pharmaceuticals, education, agriculture etc. With developing technologies, also emerge various legal regulations and issues pertaining to patents. The main objective of this Course is to integrate Patent law with technology transfer by covering variety of technical, ethical and legal aspects.

MODULE-1
UNIT-1   **10L+0T+0P=10 Hours**
INTRODUCTION TO US PATENT LAWS:
Commercial dealings: ownership, licensing, assignments, employees' inventions, Protection of discoveries, The process of getting a patent in US and India, Patent infringement: Literal infringement and a comparison of UK and US, treatment of non-literal patent infringement, Protection of information technology products and the controversy surrounding software patents, Design patents, The value of patents, Global information technology law and practice

UNIT-2   **10L+0T+0P=10 Hours**
TECHNOLOGY TRANSFER LAWS:
Internet jurisdiction, regulation of internet marketing, issues in electronic transactions, internet governance, domain name business models and disputes intellectual property challenges for new business models, legal issues raised by cloud computing, as well as net neutrality and telecom regulation, e-Finance: law, compliance and technology challenges, The impact of digital transformation of compliance in financial services on law firms, legal departments in companies, government attorneys, compliance managers, internal and external auditors, and system administrators

MODULE-2

UNIT-1   **10L+0T+0P=10 Hours**
RELATION BETWEEN IP LAWS AND TECHNOLOGY TRANSFER:
Intellectual property, innovation and development, interplay between intellectual property law, innovation social and economic development, digital and Internet innovations, Patents for cutting-edge technologies such as information technology, biotechnology and green technology, patents for biotech and pharmaceutical inventions, Patents for genetic resources/traditional knowledge and green technologies, IP-related antitrust issues, Management and commercialization of intellectual property, Technology transfer and licensing, Commercialization of innovations

UNIT-2   **10L+0T+0P=10 Hours**
ADVANCED IP LAWS:
IP portfolio management, IP issues in merger and acquisition, IP issues in franchising and outsourcing, IP and standard setting, IP and competition, IP litigation strategies, IP issues in innovation industries such as ISP's liability and safe harbour, Advanced intellectual property law, the fair use/fair dealing defense in copyright law; possible solutions to the crisis in the

entertainment industry, intellectual property protection for fashion, the treatment of standard-essential patents, reverse-payment settlement agreements in the pharmaceutical industry, extralegal intellectual property norms, traditional knowledge, relationship between intellectual property and business strategy

COURSE OUTCOMES:
Upon Successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	To understand development of Patent Law and analyse its technicalities	Analyse	1	1,2,3,4,6,8
2	To analyse the ethics, regulation and liability aspects of Patent Law regime	Analyse	1	1,2,3,4,6,8
3	To analyse the interface of Patent Law with technology transfer	Analyse	1	1,2,3,4,6,8
4	To analyse the jurisprudential and territorial aspects of patents	Analyse	2	1,2,3,4,6,8
5	To evaluate the usage of patent laws in the as one of the Intellectual Property Rights	Analyse	2	1,2,3,4,6,8

TEXT BOOKS:
1. Indian Innovators Association, "Patent IPR Licensing- Technology Commercialisation – Innovation Marketing: Guide Book for Researchers, Innovators"
2. Prasad Karhad, "How to Patent an Idea in India: From Idea to Granted Patent in Quickest Time, Saving Costs and Making Money with Your Patented Invention"

REFERENCE BOOKS:
1. K.C. Kankanala, "Indian Patent Law and Practice" (Oxford India Paperbacks)
2. Arun K. Narayana, Indian Patent Law and Practice, 2013
3. Adarsh Ramanujan, Patent Law-Cases and Materials, 2011

22LW905-RIGHT TO INFORMATION ACT

Hours per week:

L	T	P	C
4	0	0	4

PREREQUISITE KNOWLEDGE: Introduction to Legal System in India

COURSE DESCRIPTION & OBJECTIVES:
The subject deals with law relating to right to information which is one of the fundamental right implied under article 19(1)(a) of the constitution and it emphasis on application to provide a strong understanding of the fundamental concepts related to RTI.

MODULE-1

UNIT-1   **10L+0T+0P=10 Hours**
INTRODUCTION TO RIGHT TO INFORMATION:
Transparency and Information: Historical Evolution of Right to Information, Need for Information, The Need of Strengthening the process of transparency, Administrative Efficiency and Right to Information, Public Accountability and Right to Information, RTI and its relationship with Good Governance, International Perspective of Right to Information, UDHR, ICCPR, ICESCR etc, Position in other countries, Indian Constitution and Right to Information: Freedom of Speech and Expression and Right to Know/ Information under Article 19(1)(a) of the Constitution, Right to Information and right to life and personal liberty (Article 21),From Right to Privacy to Right to Information, RTI and Rights of Arrested Person (Article 22),From Right to Vote, Right to Know the Antecedents of Election Candidates, From Right to Environment, Right to Know Environmental Information

UNIT-2   **10L+0T+0P=10 Hours**
SCOPE OF RTI ACT:
 Legislating the Right to Information: History, Attempts to Breach the Officials Secrets Act, The Press Council, NIRD draft, The Freedom of Information Bill, 2000,State Laws and Administrative Instructions: The Goa Right to Information Act, Tamil Nadu Right to Information Act, The Madhya Pradesh Right to Information Act, 2000,The Rajasthan Right to Information Act, 2000,The Karnataka Right to Information Act, 2000,Delhi Government Orders on Right to Information, RTI and other Laws: The Indian Evidence Act, 1872 (Section 76),The Consumer Protection Act 1986 (Section 6),The Public Records Act, 1993,The Representation of Peoples Act, 1950, Salient Features of the Right to Information Act 2005: Scope and applicability, Interpretation Clause, Information, Right to Information, Appropriate Government, Competent Authority, Public Authority etc, Citizens Right to Information (Section 3) and practical regime of RTI, Enforceability of RTI, Mechanism under the Act

MODULE-2

UNIT-1   **10L+0T+0P=10 Hours**
JUDICIAL REVIEW AND RTI:
Public Authority under RTI Act: Definition of Public Authority, Comparison with definition of 'State' under Article 12 of the Constitution of India, Suo Motu Disclosure by Public Authorities, Obligations of Public Authority (Section 4),Judicial interpretation of Public Authority ,Status of NGO's, Political Parties, Private Persons etc., Nature of RTI, Exemptions and Limitations: Nature

of RTI, Whether absolute, Exemptions under Section 8 of the RTI, Act, Public Interest v. Protected Interest, Copyright exemption, Severability, Third Party Information, Impact of Exemptions, Exceptions and Limitations on the RTI, Implementing RTI Act: Procedure to Obtain Information, Application for Information (Section 6),Information Fee and Cost of Information, Role of APIOs and PIO, Time Schedule for disposal for Application ,Disposal of Third Party Information and procedure, RTI and Human Rights, Composition

UNIT-2   **10L+0T+0P=10 Hours**
RTI AS A TOOL FOR SOCIAL CHANGE:
Powers and Functions of the Information Commissions: Constitution of Information Commissions: Central Information and State Information Commission, Qualification of Information Commissioners and Chief Information Commissioner, Powers and Functions of the Information Commissions, Working of the Information Commissions: Analysis, Activism from the Information Commission: Theory and Effect Ecological Perspective of Right to Information, RTI and Environmental Protection, Position under the Environmental Laws, Environmental Impact Assessment, Environmental Public Hearing, Indian Ecological Perspective of Right to Know, Right to Information Act and Environment, Case Study, Right to Information and Implementation Issues: Information Audit, Spreading RTI Awareness, Misuse of RTI, Role of RTI Activists/NGO's, Balancing Private Information and Public Interest, Achieving objects of RTI, The Way Forward.

COURSE OUTCOMES:
Upon Successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	To understand the basic principles of Right to Information	Analyse	1	1,2,3,4,5,7
2	To analyse the principle of Administrative Discretion and Transparency	Analyse	1	1,2,3,4,5,7
3	To comparatively analyse the importance of Right to Information in Judicial proceedings	Analyse	2	1,2,3,4,5,7
4	To understand various procedures in filling application of RTI	Analyse	2	1,2,3,4,5,7
5	To identify and able to conduct research on emerging trends in Data interpretation and RTI	Analyse	2	1,2,3,4,5,7

TEXT BOOKS:
1. KM Shrivastava, The Right to Information: A Global Perspective (2013)
2. Sairam Bhat, Right to Information (2012)

REFERENCE BOOKS:
1. Rajvir S Dhaka, Right to Information and Good Governance (2010)
2. J N Barowalia, Commentary on the Right to Information Act (2010)
3. Dr. L. Sharma, Right to Information and Jurisprudence (2009)

MINOR ON ENGINEERING MANAGEMENT
Offered by Department of Management Studies

Engineering Management is a well-qualified course for engineering students as it provides students with all the skills an MBA can equip and integrates them extensively into the field of engineering and its applications. It is the perfect way for a person with an engineering degree to make his or her career standout by demonstrating both technical and managerial skills. Engineering graduates often covet management trainee positions. This has a huge impact on the business of engineering and can help students achieve more than a degree in engineering.

It can be expected that the students with minor course may be sought after in today's work focussed environment and are trusted with very large projects, thus making the course worthwhile. Student will be involved in leadership responsibilities across core engineering disciplines. Having knowledge of both engineering and management allows students to become techno managers that can led to take better decisions. The mathematics knowledge of engineer can be used for problem-solving as well as if student acquires management knowledge which is called as common sense and is attached with technical knowledge, then the combination will create good employable and useful techno managers.

Students are expected to get the credits by completing the following courses.

Course Code	Course Title	L	T	P	C
22MS901	Business Environment and Ethics	3	2	0	4
22MS902	Managerial Economics	3	2	0	4
22MS903	Finance for Engineers	3	2	0	4
22MS904	Engineering Entrepreneurship	3	2	0	4
22MS905	Production and Operations Management	3	2	0	4

22MS901 - BUSINESS ENVIRONMENT AND ETHICS

Hours per week:

L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Basic knowledge on business

COURSE DESCRIPTION AND OBJECTIVES:
The goal of this course is to analyse the importance of Business Environment, to gain the knowledge on pestle analysis. Students will be able to inculcate the knowledge and awareness of Indian business environment and can able to analyse the markets, customers, and competition. Also, imbibe the ethical values in the minds of young entrepreneurs.

MODULE- 1

UNIT-1   **9L+6T+0P=15 Hours**
BUSINESS ENVIRONMENT:
Introduction, Importance of Business Environment – External and Internal Environment – External Environment, Demographics, Social, Cultural, Political, Economic, Legal, Internal Environment of Business.

UNIT-2   **15L+10T+0P=25 Hours**

SOCIO-POLITICAL ENVIRONMENT:
Demographic Environment, undertaking demographic, Demographic classification, Social Environment, Undertaking Society, Social Class, and Social Status, Social Stratification, understanding family, political environment, the impact of political environment on business.

PRACTICES:
- Analyse the importance of the business environment.
- Know the impact of the political environment on business.
- Know your market, customers, and competitors.

MODULE- 2

UNIT-1   **12L+8T+0P=20Hours**
TECHNO-ECONOMIC–LEGAL ENVIRONMENT:
A brief review of industrial policies, since independence – Monetary policy – Balance of payments – Money and Capital Markets, Technological Environment–understanding technology and technology science.

UNIT-2   **12L+8T+0P=20Hours**
BUSINESS ETHICS:
Ethics Analysis based on an understanding of perceptual differences, Ethics and corporate social responsibility, Social responsibility**,** Ethical implication technology, ethics in a natural and global environment – corporate environmental responsibility.

PRACTICES:
- Understand the impact of the Technological environment on business
- Try to determine the Ethics and corporate social responsibility of your business
- Evaluate the ethical values in the minds of young entrepreneurs.

SKILLS:
- ➤ Expert in business skills
- ➤ Maintain public relations and CSR duties

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the nature and importance of Business Environment.	Analyze	1	1,2,4,5
2	Inculcate the knowledge and awareness of Indian business environment.	Apply	1, 2	1,2,5
3	Gain knowledge on pestle analysis.	Analyse	1, 2	1, 2, 3, 5
4	Analyze the markets, customers, and competition.	Analyse	2	1,2,4,5,6
5	Imbibe the ethical values in the minds of young entrepreneurs.	Evaluate	1, 2	1,2,3,4,5,6

TEXT BOOKS:

1. K. Aswathappa, "Essentials of Business Environment", 5th ed., Himalaya 2007.
2. S. K. Chakraborty, "The Management and Ethics", 5th ed., Oxford University Press, 2008.

REFERENCE BOOKS:

1. Francis cherunilam, "Business Environment Text and Cases", 17th ed., Himalaya, 2008.
2. Dutt and Sundaram, "Indian Economy",17th ed., S. Chand, New Delhi, 2009.
3. William H. Shaw, Vincent Barry, "Moral Issues in Business", 6th ed., Thomson, 2008.
4. R.C. Sekhar, "Ethical Choices in Business", 2nd ed., Response Books, 2006.

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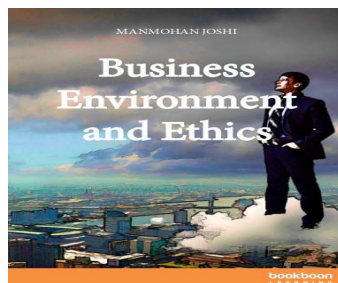
22MS902- MANAGERIAL ECONOMICS

Hours per week:

L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Basic knowledge of Economics

COURSE DESCRIPTION AND OBJECTIVES:
The goal of this course is to apply the economic way of thinking to individual decisions and business decisions and analyse how prices get determined in markets, how market participants benefit in the form of consumer surplus and producer surplus, and consequences of government intervention. The students can able to judge the different costs of production and how they affect short and long run decision and evaluate the equilibrium conditions for cost minimization and profit maximization.

MODULE-1
UNIT-1   **9L+6T+0P=15 Hours**
Introduction to Managerial Economics: Definition, Nature and Scope, Relationship with other areas in Economics, Significance of Managerial Economics in functional areas of business. The role of managerial economist. Basic economic principles

UNIT-2   **9L+11T+0P=20Hours**
THEORIES OF FIRM, DEMAND & SUPPLY ANALYSIS:
Managerial theories of the firm, Behavioural theories of the firm, Elasticity of demand, types, and significance of Elasticity of Demand. Measurement of Price Elasticity of Demand, Law of Supply, Elasticity of Supply. Need for Demand forecasting, Types of forecasting techniques.

PRACTICES:
- Survey on the practical application of laws of economics.
- Data collection on sales of consumer durable goods and predict the sales for a later year.

MODULE-2
UNIT-1   **12L+8T+0P=20 Hours**
PRODUCTION ANALYSIS:
Production function: General and specific production function Marginal Rate of Technical Substitution, Production function with one/two variables, Isoquants and Iso-costs, Least-cost combination of input factors, Cobb-Douglas Production Function, Returns to Scale and returns to factors.

UNIT-2   **12L+8T+0P =20 Hours**
COST THEORY AND ESTIMATION:
Cost concepts: Total cost, average cost, and marginal cost, fixed cost, variable cost and semi-variable cost, Acquisition and Opportunity cost, Book cost and Out of pocket cost, Historical and Replacement cost, Short run and long-run cost, Avoidable and Unavoidable cost, Incremental and Sunk cost, Traceable and Common cost determinants of cost, Cost – output relationship in the short run and long run, Average cost curves, Economies of scale. Cost-volume-profit analysis.

Pricing and Profit Management: Features and Types of different competitive situations, Price-Output determination in Perfect competition, Monopoly and Monopolistic competition both in

the long run and short run. Pricing methods in practice, Profit Management- Nature, scope, and theories of profit.

PRACTICES:
- List out low demand differentiates between normal and inferior goods.
- Analyze the role of a business economist in the everyday functioning of an organization taking live examples

SKILLS:
- ➢ To be an expert in decision-making skills
- ➢ Able to evaluate the cost of production

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the economic way of thinking to individual decisions and business decisions.	Analyze	1	1,2,4,6
2	Analyze how prices get determined in markets, how market participants benefit in the form of consumer surplus and producer surplus and the consequences of government intervention.	Analyze	1,2	1,2,3,4
3	Evaluate the equilibrium conditions for cost minimization and profit maximization	Analyze	1, 2	1,2,4,6
4	Analyze economies of scale, diseconomies of scale, economies of scope, and cost complementarities, and how each affects the cost of production.	Analyze	1, 2	1,2,3,4,5,6
5	Evaluate the different costs of production and how they affect a short and long-run decision	Evaluate	2	1, 2, 3, 5

TEXTBOOK

1. Maheshwari K. L., Varshney R.L., Managerial Economics, 22nd Revised Edition 2014, Sultan Chand & Sons.

2. A.R. Arya Sri, Managerial Economics and Financial Analysis, TMH, 2/e, 2010.

REFERENCE BOOKS

1. Dominick Salvatore, Managerial Economics in a global economy, Indian Edition; Fourth Edition, McGrawHill, 2011.

2. Craig H Peterson, W. Cris Lewis, Sudhir. K. Jain; Managerial Economics, 4/e, Pearson Publications.

3. P.L. Mehta; Managerial Economics, 21/e, Sultan Chand & Sons, 2016.

4. M.L. Trivedi; Managerial Economics Theory and Applications, McGraw Hill, 2002.

Image source: https://www.thesisbusiness.com/wp-content/uploads/2021/04/managerial-economics.jpg
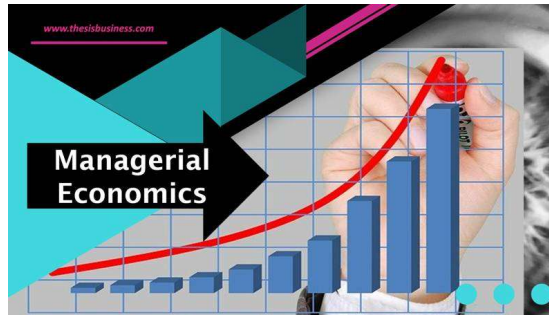
Hours per week:

L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Basic knowledge on Accounts

COURSE DESCRIPTION AND OBJECTIVES:
The goal of this course is to construct journal entries, ledger accounts, and trial balance. Students can able to analyze the performance of the organization through Trading, profit & loss, and balance sheet, and apply the Depreciation Methods, Inventory Valuation Methods in the Company/ industry, also students can able to compute the value of shares and debentures of the Company/industry.

MODULE-1

UNIT-1   **9L+6T+0P=15 Hours**
INTRODUCTION TO ACCOUNTING:
Concept of Accounting, Objectives of Accounting, Accounting Principles, Accounting cycle, classification of Accounting, Double-entry bookkeeping system, users of accounting information.

UNIT-2   **15L+10T+0P=25 Hours**
CLASSIFYING BUSINESS TRANSACTIONS:
Concept of Journal, preparation, Preparation of Journal entries, Concept of Ledger, Preparation of Ledger Accounts, Concept of Trail Balance, and Preparation of Trial Balance.

PRACTICES:
- Prepare journal entries and ledger Accounts in any organized companies in the society.
- Find out the financial position of the organization at the end of every year, through the trading account, profit & loss account, and balance sheet.

MODULE-2

UNIT-1   **12L+8T+0P=20 Hours**
SUMMARIZING BUSINESS TRANSACTIONS:
Concept of Trading Account, Preparation of Trading Account, Profit and Loss Account, and Balance sheet with simple adjustments.

UNIT-2   **12L+8T+0P=20 Hours**
WORKING CAPITAL AND RATIO ANALYSIS:
Concept of Working Capital, Factors determining Working Capital, Types of Working Capital, Determining Working Capital requirements, Concept of ratio analysis, types of ratios-liquidity ratios, leverage ratios, profitability ratios, and turnover ratios.

PRACTICES:
- Calculate the various methods of depreciation on Machinery, buildings, and Furniture.
- Find out the methods of inventory evaluation.
- Prepare the company accounts.

SKILLS:
- Excellent analytical ability and interpersonal skills
- Expert problem-solving abilities
- Ability to make better financial decisions

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyzing the accounting concepts, conventions, and principles of Accounting.	Analyze	1	1,2,4,5
2	Construct journal entries, ledger accounts, and trial balance.	Apply	1	1,2,5
3	Analyze the performance of the organization through Trading, profit & loss, and balance sheet.	Analyze	1, 2	1, 2, 3, 5
4	Apply the Depreciation Methods and Inventory Valuation Methods in the Company/ industry.	Analyze	2	1,2,4,6
5	Compute the value of shares and debentures of the Company/industry.	Evaluate	1, 2	1,2,3,4,5, 6

TEXT BOOKS:
1. S.P. Jain, K.L Narang "Financial Accounting", 3rd Edition, Kalyani Publishers, 2016.
2. Jain S.P., & Narang K L. "Basic Financial Accounting", 1st Edition, Kalyani publishers,2014.

REFERENCE BOOKS:
1. Maheshwari, S.N., & Maheshwari, S.K. "Advanced Accountancy", 10 th Edition, Vikas house publication ltd, 2010.
2. Shukla, M. "Advanced Accounts" 19th Edition, S Chand Group, 2016.
3. Radhaswamy, M & Gupta, R.L. "Advanced Accountancy" 17th Edition, Sultan Chand &Sons, 2014.
4. Jawahar Lal,Seea Srivastava, "Financial Accounting-Principles And Practices:, 3rd Edition, S. Chand, NewDelhi, 2014.

Image source: https://leverageedublog.s3.ap-south-1.amazonaws.com/blog/wp-content/uploads/2018/03/09201342/Financial-Engineering.jpg

22MS904- ENGINEERING ENTREPRENEURSHIP

	L	T	P	C
Hours per weak	3	2	0	4

PRE-REQUISITE KNOWLEDGE: Basic knowledge on Business

COURSE DESCRIPTION AND OBJECTIVES:
The goal of this course is to evaluate entrepreneurial mindset and culture that has been developing in companies of all sizes and industries. The students will be able to create and present a business plan for a technology idea and will experience the dynamics of participating on a business team and the power inherent in a team relative to individual effort. Also students can able to apply tools and life skills required to participate in the entrepreneurial process within a large company, in a new venture, or as an investor.

MODULE - 1
UNIT-1   **9L+6T+0P=15 Hours**
ENTREPRENEURSHIP:
Introduction to   Entrepreneurship, Technology, Entrepreneurship and Technology Ventures, Attributes and Myths of Technology Entrepreneurs, Engineers as Entrepreneurs, The Mind-se of the Entrepreneurial Leader, Creating and Selling the Entrepreneurial Value Proposition.

UNIT-2   **15L+10T+0P=25 Hours**
ENTREPRENEURIAL IDEA GENERATION:
Entrepreneurial Idea Generation and Feasibility Analysis, Technology   Commercialization Potential, Paths and Barriers from Idea to Market, Assessing and Presenting the Opportunity.

PRACTICES:
- Imagine you want to start an enterprise; what attributes do you need to possess to make it successful
- Apply the concepts of the entrepreneurial process you studied and explain how you would start your own enterprise

MODULE-2

UNIT-1   **12L+8T+0P=20 Hours**
BUSINESS STRUCTURING AND STRATEGY:
Business Structuring and Strategy, Business Planning and the Business Plan, Financial Analysis and Projections; Market and Competitive Analysis, Presentation of the   Opportunity,

UNIT-2   **12L+8T+0P=20 Hours**
INTELLECTUAL PROPERTY STRATEGIES:
Intellectual Property Strategies for Technology Companies; Marketing, Sales and Distribution Strategies, Investment and Financial Strategies, Venture Growth and Value Harvesting.

PRACTICES:
- Formulate a B-Plan to launch a venture that creates online video tutorials. Write a short note of each aspect clearly.
- Entrepreneurs face many barriers on their way to success, list a few and explain.

- Practice problems related to project management techniques.

SKILLS:
- ➢ Can gain knowledge on entrepreneurship.
- ➢ Able to analyze the motivating factors of entrepreneurship.
- ➢ Able to analyze the markets, customers, and competition.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze practices of technology entrepreneurial thinking and entrepreneurship.	Analyze	1	1,2,3,5
2	Evaluate the entrepreneurial mindset and culture that has been developing in companies of all sizes and industries.	Evaluate	1, 2	1,2,3,4,5
3	Analyze the Entrepreneurial process from the generation of creative ideas to exploring the feasibility of the creation of an enterprise for implementation of the ideas.	Analyse	1, 2	1, 2, 3, 5
4	Create and present a business plan for a technology idea. Students will experience the dynamics of participating on a business team and the power inherent in a team relative to individual effort.	Analyse	2	1,2,3,5
5	Apply tools and life skills required to participate in the entrepreneurial process within a large company, in a new venture, or as an investor.	Evaluate	1, 2	1,2,3,4,5,6

TEXT BOOKS:
1. H. Nandan, "Fundamentals of Entrepreneurship", 5th ed., PHI, New Delhi, 2007.
2. Technology Ventures: From Idea to Enterprise, 3rd Edition, Dorf, Richard, Byers, Thomas, and Nelson, Andrew; ISBN 978-0073380186
3. New Venture Creation, 6th Edition or 5th Edition, Timmons, Jeffry A; ISBN:0072498404, January 2004.

REFERENCE BOOKS:
1. Robert D Hisrch, Michael P Peters, Dean A Shpherd, "Entrepreneurship", 6th ed., New Delhi, 2006.
2. Dr. C. B. Gupta, Dr. S. S Khanka "Entrepreneurship and Small Business Management", 4th ed., Sultan Chand & Sons, New Delhi.
3. Dr. C. B. Gupta, Dr. N.P. Srinivasan "Entrepreneurship Development in India", 5th ed., Sultan Chand & Sons, New Delhi.
4. The Art of the Start: The time-tested, battle-hardened guide for anyone starting anything, Kawasaki, Guy; ISBN: 1591840562, Portfolio – a member of Penguin Group; 2004 Monk & the Riddle, Komisar, Randy; ISBN: 1578516447, Harvard Business School Press; September 2001.
5. Sun Tzu for Success: How to Use the Art of War to Master Challenges and Accomplish the Important Goals in Your Life, Michaelson, Steven; ISBN: 1580627765, Adams Media Corp, January 2003.

Image source: https://annamacharyagroup.org/wp-content/uploads/2018/04/engineer-to-an-entrepreneur-09-04-2018.jpg
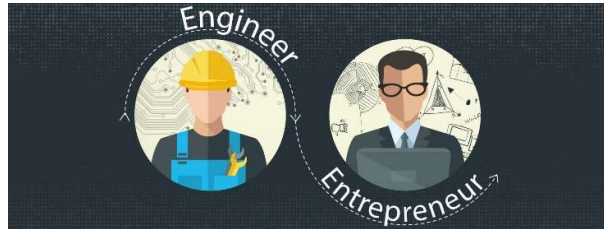
22MS905 - PRODUCTION AND OPERATION MANAGEMENT

Hours per week:

L	T	P	C
3	2	0	4

PRE-REQUISITE KNOWLEDGE: Production and operation Management.

COURSE DESCRIPTION AND OBJECTIVES: By the end of this course it is expected that the student will be able to:
1. Analyze the concepts of Operations and Production in actual business process.
2. Analyze the issues of OM in both manufacturing and service organizations.
3. Applying operations management policies and techniques to the service sector as well as manufacturing firms.
4. Applying analytical skills and problem-solving tools to the analysis of the operations problems.
5. Creating and enhancing a firm's competitive advantages by understanding the strategic role of production and operations management.

MODULE -1
UNIT-1   **5L+10T+0P=15Hours**
Production Systems and Productivity: the concept of Production, characteristics of modern production operations management, recent trends in production and operations management, Types of Production Systems, Productivity- Basic concepts, measurement of productivity – total productivity, factor productivity, methods for improvement of productivity.
Product design, new product development, and value engineering.

UNIT-2   **5L+10T+0P=15Hours**
Plant location and layout: Factors affecting plant location and layout, types of plant layouts – process, product, and fixed-position layout. Material management- inventory control, purchase function, ABC analysis, Economic Order Quantity (EOQ), and just-in-time concept.

PRACTICES:
- Analyze any factory and list out the physical facilities and type of production followed.
- Analyze and prepare a report on the production planning and control activities
- Analyze and draw a chart on plant layout/ suggest suitable methods for productivity improvement.
- Practice problems on Inventory control method.

MODULE - 2
UNIT-1   **6L+9T+0P=15Hours**
Work-study and Quality Control: – Method study, Time study, Standard time calculations, work sampling, Plant Maintenance – preventive, breakdown, total productive maintenance,

Reliability concept and calculations, Quality control – quality, quality control, quality control vs inspection, and statistical quality control. Control charts for variables and attributes. Six Sigma, ISO series, TQM & Demings contribution to quality.

UNIT-2   **4L+11T+0P=15Hours**
Modern production & international operations management: Just-in-time manufacturing, kaizen, Business process reengineering, supply chain management, lean manufacturing, Nature of international operations management- Strategic issues, outsourcing, managing service operations, international quality standards, TQM, internationalization of R & D.

PRACTICES:
- Analyze the functions of materials management in an organization.
- Evaluate the industry and list out the various quality measures /maintenance methods adopted.
- Practice problems on work-study and Quality-control methods.

SKILLS:
- To be an expert in problem-solving and analytical skills
- Able to evaluate firm's competitive advantages

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Applying operations management policies and techniques to the service sector as well as manufacturing firms.	Apply	2	1, 2, 3, 5
2	Analyze the concepts of Operations and Production in actual business process.	Analyze	1	1,2,4,6
3	Analyze the issues of OM in both manufacturing and service organizations.	Analyze	1,2	1,2,3,4
4	Applying analytical skills and problem-solving tools to the analysis of the operations problems	Analyze	1, 2	1,2,4,6
5	Creating and enhancing a firm's competitive advantages by understanding the strategic role of production and operations management.	Evaluate	1, 2	1,2,3,4,5,6

TEXT BOOKS:
1. R. Paannerselvam, "Production and Operations Management", 2nd ed., PHI 2006.
2. K. Aswathappa, K. Sridhara Bhat, "Production and Operations Management", 2nd ed., HPH, 2010.

REFERENCE BOOKS:
1.S. N. Chary, "Production and Operations Management", 6th ed., Tata McGraw-Hill, 2006
2.Buffa, "Modern Production Operation Management", 6th ed., Willey 2008.
3.Joseph S Matrinich, "Production and Operations Management", 8th ed., Willey 2008.

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https://thumbs.dreamstime.com/b/operations-management-business-technology-concept-virtual-screen-operations-management-business-technology-concept-113495331.jpg

MINOR ON ENTERPRENEURSHIP AND IPR

Offered by Department of Management Studies

The Entrepreneurship and Intellectual property rights (IPR) minor fosters development of a creative, visionary mindset and spirit and prepares students to be opportunity seekers and creators that identify, evaluate, and implement innovative, value-added solutions. The minor includes discipline-specific courses intended to aid students' course selection. This minor offered in tune with Knowledge India, the slogan **(Jai Vignan)** given by honorable prime minister of India.

In the recent decades, with the development of science and technology world has seen shifts in economy from farming to industry to knowledge. Today we are in technology driven, knowledge-based era of which foundation is intellectual involvement. Institutional IP policy is one of the policies which plays major role in R & D management to enhance innovation and entrepreneurship.

Computational thinking could seed entrepreneurship if we provide our computer science and software engineering students with entrepreneurial skills and discover potential entrepreneurs among them. In the past few years, Indian companies created Intellectual Property as a part of a customized software development contract with a distant client. Internet of things is about the enhancement of business processes and solutions with sensors, devices, gateways and platforms which explores lot of services in all the sectors such as Mechanical, Civil, Agricultural, Biotechnology, Biomedical, Computer science & IT and Electrical and Electronics Engineering applications.

Agriculture Entrepreneurship can help tackle the challenges related to information dissemination, farm management, capital availability, mechanization of farm and the agriculture supply chain. In health care, intellectual property rights give their owners exclusive use of pharmaceuticals, brand names and more. Intellectual property rights are often the primary driver of value for these companies, particularly in biotechnology.

Course Code	Course Title	L	T	P	C
22MS906	Entrepreneurship Development	2	2	2	4
22MS907	Product Ideation and Prototype Development	2	2	2	4
22MS908	Property Rights	2	2	2	4
22MS909	Marketing and Finance for Startups	2	2	2	4
22MS910	Startup Internship / Summer Project	2	2	2	4

22MS906-INTRODUCTION TO ENTREPRENEURSHIP

Hours per week:

L	T	P	**C**
3	2	0	**4**

PREREQUISITE KNOWLEDGE: Basics of Engineering, science, humanities, computer applications and management.

COURSE DESCRIPTION AND OBJECTIVES: The course is designed to make the students understand the concept of entrepreneurship and its contribution towards country's economy. The course is also framed to make the students understand the government support in promoting entrepreneurship.

MODULE-1

UNIT-1   **10L+8T+0P=18 Hours**
INTRODUCTION TO ENTREPRENEURSHIP:
The Raise of Startups: Startup scenario in India - The New Industrial Revolution- The Big Idea-Generate Ideas with Brainstorming-Business Startup-Ideation-Venture Choices- The Rise of the startup Economy—The Six Forces of Change- The Startup Equation- The Entrepreneurial Ecosystem- Entrepreneurship in India.

UNIT-2   **14L+8T+0P=22 Hours**
Innovations in Startups: Concept, need, factors, life cycle, Introduction to innovation and disruptive innovation, Technology based start-ups, characteristics of Tech startup, new startup model, Business plan and its components, key factors for success and reasons for failure. Central Government support to startups.

PRACTICES:
- Prepare a brief case study based on any successful local entrepreneur by analyzing the failures and success factors
- List out and analyze the profiles of any three new age Entrepreneurs.
  Develop case analysis on Technopreneur ship

MODULE-2

UNIT-1   **8L+8T+0P=16 Hours**
BUSINESS PLANNING, THE ROLE OF THE GOVERNMENT IN PROMOTING ENTREPRENEURSHIP:
Legal and Financial aspects of the Entrepreneurship: statutory requirements for startups, Entrepreneurs and legal regulatory systems, patents and trademarks, Intellectual Property Rights, Financing by Commercial Banks, Bank Loans, specific type of finance like Angel investors, Venture capital, funds from Mudra Bank, Government Grants and Subsidies

UNIT-2   **16L+8T+0P=24 Hours**
Business Planning, and Feasibility Studies: The Concept of Business planning and modeling, Importance and contents of business plan, Internal and External Environment Analysis,

Technological Competitiveness, Feasibility, SWOT Analysis, Product and Process Development, Major steps in product development.

MSME and Entrepreneurship Development: Role of DIC, SIDBI, SIDO, NISIET, SISI and PMEGP in promoting Entrepreneurship. Industrial sickness – Reasons for sickness and Revival measures.

PRACTICES:
- Convert your business ideas by drafting a business plan and carefully evaluate the possible business opportunities.
- Visit the DIC and make list of the various existing institutions supporting Entrepreneurs in Andhrapradesh and analyze the facilities provided by them.
- Develop case analysis on Silicon Valley.

SKILLS:
- Ability to discover new problems and revel potential niche opportunities.
- Ability to render strategic thinking in developing the startups
- Ability to face the real time challenges during entrepreneurial journey
- Ability to create employment after floating a successful startup such that contribute the economy.
- Ability to pull the funding from various sources, both government and non-government.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1.	Understand concepts, process and types of entrepreneurships and apply these in real time startups	Apply	1	1, 9, 12
2.	Identify various Legal and Financial aspects of the Entrepreneurship	Analyze	1	1, 8, 10, 12
3.	Able to develop skills in the area of conducting feasibility studies, analysis of opportunities and strategies and promotion of entrepreneurship	Analyze	1	2, 5, 7, 9
4.	Evaluate the contribution of MSME towards the country's economy	Evaluate	2	8, 9, 10

TEXT BOOKS:
1. H. Nandan, Fundamentals of Entrepreneurship, 1st Edition, PHI, New Delhi, 2007.
2. Thomas W. Zimmerer, Norman M. Scarborough, Essentials of Entrepreneurship and Small Business Management, 4th Edition, Pearson, New Delhi, 2006.

REFERENCE BOOKS:
1. Madhurima Lall, Shikha Sahai, entrepreneurship, 1st Edition, Excel Books, New Delhi, 2006.
2. S.S. Khanka, Entrepreneurial Development, Revised Edition, S. Chand and Company Limited, New Delhi, 2007.
3. Thomas W. Zimmerer, Norman M. Scarborough, Essentials of Entrepreneurship and Small Business Management, 4th Edition, Pearson, New Delhi, 2006.

4. Charles E. Bamford, Garry D. Bruton Entrepreneurship: a small business approach, 1st Edition, McGraw-Hill, New Delhi, 2010.

Image file name: **INTRODUCTION TO ENTREPRENEURSHIP**

22MS907-PRODUCT IDEATION AND PROTOTYPE DEVELOPMENT

Hours per week:

L	T	P	C
3	2	0	**4**

PREREQUISITE KNOWLEDGE: Entrepreneurs need to have an understanding of business models basics and ideation/project models preparation etc.,

COURSE DESCRIPTION AND OBJECTIVES:
The students typically have an aptitude to develop interesting applications, while learning from the same. The course enables the students get a credit advantage for the same, share and discuss ideas, get feedback from the mentors and peers, and also aim towards deployment and real-world testing of the project. The focus is primarily towards projects with a business application, which makes it different from the existing semester projects.

MODULE-1

UNIT-1   **8L+8T+0P=16 Hours**

Ideation, Business Model Canvas and Value Proposition.

UNIT-2   **16L+8T+0P=24 Hours**

Customer Identification, Identifying Competence

PRACTICES:
- Deciding features of the prototype.
- Development of one feature of the prototype

MODULE-2

UNIT-1   **10L+8T+0P=18 Hours**

Distribution and revenue models, Assumptions and Validations

UNIT-2   **14L+8T+0P=22 Hours**

Pitching techniques

PRACTICES:
- Complete prototype development.
- Prototype Demonstration.

SKILLS:
- ➢ Ability to apply design thinking approach.
- ➢ Ability to build business models of prototypes using lean canvas methods
- ➢ Ability to deploy the ideation to prototype of respective technologies.
- ➢ Ability to develop useful revenue models for a prototype development
- ➢ Ability to develop a competent prototype of given domain

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Develop a business model canvas for the ideas, develop and implement the ideas.	Apply	2	7,8,9,11
2	Describe importance of product innovation	Analyze	1	3,5,8,11
3	Describe the new product development process	Analyze	1	5,7,8,9
4	Explain the stages of product life cycle	Analyze	1	7,8,10
5	Describe the marketing strategies at different stages of product life cycle.	Analyze	2	7,8,12

TEXT BOOKS:

1. Arie Karniel and Yoram Reich **"**Managing the Dynamics of New Product Development Processes: A New Product Lifecycle Management Paradigm**"** 2011th edition, Springer, 2014
2. **Michael G. Luchs, Scott Swan, Abbie Griffin" Design Thinking: New Product Development Essentials from the PDMA" 1st edition, Wiley-Blackwell,2015.**

REFERENCE BOOKS:

1. **Alexander Osterwalder, Yves Pigneur "Business Model Generation" Wiley-Blackwell,2015.**
2. Steve Blank, The Starup Owner's Manual, Wiley-Blackwell,2020.
3. Eric Rea's, "The Lean Startup", Currency,2011

Image file name: **PRODUCT IDEATION AND PROTOTYPE DEVELOPMENT**

Hours per week:

L	T	P	C
3	2	0	**4**

PREREQUISITE KNOWLEDGE: Entrepreneurs need to have an understanding of basics of IPR and its importance etc.,

COURSE DESCRIPTION AND OBJECTIVES:
This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations.

MODULE-1
UNIT-1   **10L+8T+0P=18 Hours**
INTRODUCTION TO INTELLECTUAL PROPERTY:
Introduction, Types of Intellectual Property, International Organizations, Agencies and Treaties, Importance of Intellectual Property Rights- The impact of IPR filing at the national level and its importance in the fundamentals of MAKE IN INDIA along with START-UPS.

UNIT-2   **14L+8T+0P=22 Hours**
TRADE MARKS AND PATENTS:
Purpose and Function of Trade Marks, International perspectives of Trademarks Acquisition of Trade Mark Rights, Protectable Matter, Selecting and Evaluating Trade Mark, Trade Mark Registration Processes- Patent office and Appellate Board.
Law of Patents: Foundation of Patent Law, International perspectives of Patents, Patent Searching Process, Registration Procedure, ownership Rights and Transfer

PRACTICES:
- Group Discussion over diverse national and International IPR related issues.
- Procedure for drafting and filing of Patents

MODULE-2
UNIT-1   **6L+8T+0P=14 Hours**
Law of Copy Rights & Trade Secrets: Fundamental of Copy Right Law, International perspectives of Copyright, originality of Material, Rights of Reproduction, Rights to Perform the work publicly, Copy Right ownership Issues, Copy Right Registration, Notice of Copy Right Trade Secrets Law, International perspectives of Trade Secrets, Determination of
Trade Secrets Status, Liability for Misappropriations of Trade Secrets, Protection
for Submission, Trade Secrets Litigation., False Advertising

UNIT-2   **16L+8T+0P=24 Hours**
OTHER FORMS OF IP AND RECEN TTRENDS:
Design Patent: Meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection

Geographical Indications: Overview and registration procedure under Geographical Indications of Goods (Registration and Protection) Act, 1999

Plant Varieties: Overview of the Protection of Plant Varieties And Farmers' Rights Act, 2001- types of varieties, registration etc.

Recent advances In Trade Mark Law; Copy Right Law, Patent Law, Intellectual Property Audits, Artificial Intelligence and IP, Cryptocurrency and IP etc.

PRACTICES:
- Procedure for drafting and filing of Copyrights, Patents.
- Procedure for drafting and filing of Design Patent, GI, Plant varieties

SKILLS:
- Ability to have a competitive edge over other similar businesses.
- Ability to draft the patent for proper filing
- Acquires the knowledge on Copy rights, trademarks and trade secrets
- Ability to convert the idea to startup in competent areas.
- Ability to enhance business market value
- Ability to export the business products/services

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge towards trademarks, trade secrets and copy rights	Apply	1	1, 3,6,8,12
2	Ability to draft the patent/design	Analyze	1	3,6,8,12
3	Analyze the scope of research and industry works for patenting	Analyze	2	1, 2, 3,6
4	Ability to explore the knowledge on patent laws at both national and international level	Analyze	2	2, 3, 6,8, 12
5	Able to identify the scope of IP filing	Evaluate	1	1,3,6, 8

TEXT BOOKS:
1. Deborah. E. Bouchoux "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning India Private Limited, 4th edition,2013.
2. Ganguli Prabuddha "Intellectual Property Rights--Unleashing the Knowledge Economy", Tata McGrawHill 2001.

REFERENCE BOOKS:
1. Dr.G.B. Reddy,"Intellectual Property Rights and the Law", Gogia Law agency, 2017.
2. Inventing the Future: An introduction to Patents for small and medium sized Enterprises; WIPO publication No. 917. URL: www.wipo.int/ebookshop.
3. Looking Good: An Introduction to Industrial Designs for Small and Medium-sized Enterprises; WIPO publication No.498. URL: www.wipo.int/ebookshop.

4. Creative Expression:An Introduction to Copyright and Related Rights for Small and Medium-sized Enterprises; WIPO publication No. 918.URL: www.wipo.int/ebookshop

Image file name: **INTELLECTUAL PROPERTY RIGHTS**

22MS909-MARKETING AND FINANCE FOR STARTUPS

	Hours per week:		
L	T	P	C
3	2	0	**4**

PREREQUISITE KNOWLEDGE: Entrepreneurs need to have an understanding of business fundamentals and acquire skills related to startup marketing and finance

COURSE DESCRIPTION AND OBJECTIVES:
This course provides a holistic view of business environment and various aspects of customer discovery, problem solving, go-to-market elements, accounting, financial planning & fund raising. Students will work in terms on real-world customer problem solving.

MODULE-1
UNIT-1   **8L+8T+0P=16 Hours**
Business and Business Environment: Types of companies; company functions; company structure, company legal requirements, Company Governance: Vision, Mission and Strategy, Leadership, Business ethics

UNIT-2   **16L+8T+0P=24 Hours**
MARKETING AND SALES FOR ENTREPRENEURS:
Customer discovery: Personal Branding, Team formation, Customer Problem & Marketing Sizing, Customer Personal.
Customer Value Delivery: Branding & Digital Advertising, Pricing Plan, Go-to-Market and After-Market Plan, Sales and Supply Networks
Customer Relationship Management: Sales Strategy, Sales Force Skills and CRM tools.

PRACTICES:
- Identify different business environment factors for any industry.
- Take any company of your interest and create Vision, Mission and Strategy, Leadership policies
- Demonstrate sales force skills
- Analyze the importance of Digital Advertising

MODULE-2
UNIT-1   **10L+8T+0P=18 Hours**
Basics of accounting terminology, Assets, Liabilities, Revenue, Costs, Cashflows
Financial Statements analysis, financial projections and Break-even Analysis

UNIT-2   **14L+8T+0P=22 Hours**
Corporate Finance Basics: Objective of a business firm, Time Value of Money, Three key decisions of a firm (Investment, Financing, Dividends),
Source of startup Financing: Bootstrapping Grants, Incubators and Accelerators, Friends and Family Angel investors, Venture Capital

PRACTICES:
- Prepare Cash-flows statements for any organisation
- Take a Balance sheet of any company of your choice and prepare Financial Statements analysis.
- Give a presentation on Sources of startup Financing
- Draft a case study on Friends and Family Angel investors.

SKILLS:
➢ Ability to effectively manage finances in critical situations of any startup.
➢ Ability to have Complex Problem Solving of a startup.
➢ Ability to exhibit marketing mix techniques
➢ Ability to maintain a stream of finance to keep a successful startup
➢ Ability to float the new marketing strategies in to a new startup

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Role play on Customer – Executive Interaction	Apply	1	1, 9, 10
2	Role Play on different Investment decisions.	Apply	2	8, 9, 10, 12
3	Design Customer Relationship Management tools for a company of your choice	Analyze	1	3,8,9,11
4	Develop a Logo and Tagline for the brand know to you	Analyze	1	3,7,9
5	Analyze the scope of Incubators and Accelerators.	Analyze	2	5,8,9,10,11

TEXT BOOKS:
1. Philips Kotler, Gary Armstrong & Prafulla Agnihotri, Principles of marketing,17th Edition, Pearson.
2. Jerry J.Weygandt, Paul D.Kimmal, Donald E.Kieso, Financial and Managerial accounting, McGraw Hill Education,2019 (1119537250)

REFERENCE BOOKS:
1. Eric Ries, The lean Startup, Penguin Publications,2011
2. Vijaya Ivaturi,Meena Ganesh, Alok Mittal, Sriram Subramanya, Prof Sadagopan, The Manual for Indian Startups, 2nd Editon, Penguin Enterprise,2020
3. Alejendro Cremades, The art of startup fundraising: Pitching investors, negotiation the deal, and Everything Else Entrepreneurs need to know, Jhon Wiley & Sons, 2018, ISBN-13:978-8126572588.

Image file name: **MARKETING AND FINANCE FOR STARTUPS**

MINOR ON EVENT MANAGEMENT

Offered by Department of Management Studies

Event management is the process of planning, coordinating, and executing events such as conferences, meetings, festivals, and concerts. Event managers are responsible for every aspect of an event, from choosing the venue to managing suppliers and dealing with any issues that may arise on the day of the event. Event management is a complex and demanding profession, but it can also be hugely rewarding. A successful event can bring people together, create memories that will last a lifetime, and generate positive publicity for a company or organization. In today's increasingly competitive business world, event management is more important than ever before. A well-organized event can help a company to stand out from its rivals and attract new customers and clients. With the right event management team on your side, you can be sure that your event will run smoothly and be a success.

Events have become an inseparable and integral part of both personal and professional life today. Among the large number of family gatherings, birthdays, anniversaries, weddings and baby showers are few of the most common ones. In the official arena the few that come to mind immediately are MICE-, meetings, incentives, conferences and exhibitions. Then there are special events like television and reality shows, Sports Management and marketing, international events and concerts, celebrity and artist management, fashion shows, product launches, road shows and promotional events. There is obviously a huge demand for man power at different levels of management. For an industry that is expected to cross 10,000 crores by 2023, the supply of trained professionals is definitely not meeting the constantly rising demand. Hence a certification promises you lucrative career opportunities especially if it is from a premier institute like VFSTR

A minor degree enhances your skills like interpersonal skills, communication, PR, marketing, negotiation, public speaking and presentation, team management and team play, the ores to a successful career in event management. Swimming is best learnt when you are thrown in to the water. Similarly, soft skills are also best learnt when you are on the field. There could be nothing better than Event Management that will sharpen a range of such skills within the shortest possible time span. And there are all the possibilities that by the time you finish a certification you will have fallen in love with Event Management too. At VFSTR industry experts from leading brands contribute towards your preparation for future ventures. There are specially designed boot camps, workshops, seminars and conferences etc. keeping these special needs of students in mind.

Event Management is an industry that embraces the latest and best technology every day. Well-structured courses like that at VFSTR will help you learn and adapt to latest technology a methodology faster than you would through experiment and exploration.

Students are expected to get the credits by completing the following courses.

Course Code	Course Title	L	T	P	C
22MS911	Event Management Planning	2	0	4	4
22MS912	Event Production Process	2	0	4	4
22MS913	Event Hospitality, Law and Permissions	2	0	4	4
22MS914	Event Cost Accounting and Finance Management	2	0	4	4
22MS915	Event Risk Management	2	0	4	4

MINOR ON RELIABILITY ENGINEERING
Offered by Department of Mechanical Engineering

The industrial, electrical, mechanical, IT and other design engineers attempt to create a product/application that operates as intended, providing the functionality the customer expects. Successful designers do this elegantly, balancing cost, performance, time to market, and reliability along with a long list of other considerations, such as sustainability, recyclability, safety, manufacturability, and maintainability.

Industrial systems are becoming increasingly complex, the competitive environment is tougher than ever and the need for manufacturing or process operations to perform optimally has never been greater.

Reliability is a common denominator for success. Those organizations that have a strong culture of reliability across every aspect of their operation will be more likely to succeed over the long-term.

"Reliability is Prerequisite of the Trust whether it's a Product/Service/Person"

We at VFSTR offering this as a Minor Degree which enable the students to acquire the knowledge of the application of reliability principles in designing/developing failure free hardware/software products. This Minor degree allows the students from divergent disciplines to acquire the knowledge of reliability through the following courses:

- **Fundamentals of Reliability**
- **Design for Reliability**
- **Maintenance Engineering**
- **Reliability Estimation and Life Testing**
- **Safety Engineering**

The present average salary for a professionally certified reliability engineer in the United States is **$97,434 per year**. Pay may vary depending on geographic location, education and professional experience.

Reliability Knowledge make the students to pursue professional certification in Reliability that have a scope of good jobs in industries.

Course Code	Course Title	L	T	P	C
22ME901	Design for Reliability	3	2	0	4
22ME902	Fundamentals of Reliability	3	2	0	4
22ME903	Maintenance Engineering	3	2	0	4
22ME904	Reliability Estimation and Life Testing	3	2	0	4
22ME905	Safety Engineering	3	2	0	4

22ME901-DESIGN FOR RELIABILITY

PREREQUISITE KNOWLEDGE: Basics of Mathematics

COURSE DESCRIPTION AND OBJECTIVES:
The purpose of this course is to introduce the graduate students and practicing engineers to the theories of reliability and quantifying reliability in product design.

MODULE-1

UNIT-1   **6L+6T+0P=12 Hours**
Probabilistic Engineering Design: Methodology, Stress and Strength Distributions, Safety Factors and Reliability, Reliability Bounds in Probabilistic Design, Transformation of Random Variables, Expectation and Variance of a Function of Random Variables, Computations of Moments of a Function of Random Variables.

UNIT-2   **10L+10T+0P=20 Hours**
Reliability Design: Tension element, I – beam, shaft subjected to torsion, column.

PRACTICES:
- ✓ Reliability Prediction for a randomly distributed stress and strength.
- ✓ Reliability Estimation of time dependent Stress – Strength Models.

MODULE-2

UNIT-1   **6L+6T+0P=12 Hours**
Time Dependent Stress Strength Models: Classification, reliability computations - Deterministic Cycle times, random cycle times, Aging, Cyclic damage and cumulative damage.
Dynamic Reliability Models: Series system, Parallel System, Stand – by redundant system, shared load parallel system

UNIT-2   **10L+10T+0P=20 Hours**
Bayesian Reliability and Optimization: Bayesian approach, application of Bayesian theorem in design for reliability, design for reliability of a component subjected to random stresses, Reliability Allocation, Dynamic programming, and optimization in probabilistic design.

PRACTICES:
- ➢ Reliability Computation for Series, Parallel and Mixed Dynamic Configurations.
- ➢ Reliability Optimization of Systems.

SKILLS:
- ➢ Failure data Analysis.
- ➢ Hazard Estimation.
- ➢ Reliability Prediction and Estimation.
- ➢ Prediction of reliability for a given failure rate or hazard rate.
- ➢ Reliability Computation for Series Configurations.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Evaluate reliability of components subjected to random stresses.	Apply	1	1, 2, 9, 11
2	Calculate the reliability of dynamic reliability models.	Analyze	2	1,2,9
3	Perform reliability optimization and Bayesian approach.	Evaluate	2	1,2,9
4	Predict the Reliability of components at Design Stage.	Create	1	1, 2,9, 11

TEXT BOOKS:
1. Charles E. Ebling, "An Introduction to Reliability and Maintainability Engineering", Tata Mc Graw Hill, Indian Edition, 2017.
2. Alessandro Birolini, "Reliability Engineering: Theory and Practice", Springer, 8th Edition, 2017.

REFERENCE BOOKS:
1. K. C. Kapur and L R Lambersan, "Reliability in Engineering Design", Wiley, 1st Edition, 2011.
2. Elsayed A. Elsayed, "Reliability Engineering", Wiley, 2nd Edition, 2011.

Image source: https://qphs.fs.quoracdn.net/main-qimg-caa1625521dba35be9b7f9cad262c0e3-pjlq

Image file name: DESIGN FOR RELIABILITY

22ME902-FUNDAMENTALS OF RELIABILITY

	L	T	P	C
Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of Mathematics

COURSE DESCRIPTION AND OBJECTIVES:
This course applies the fundamental concepts of reliability engineering and their relevance to engineering systems. The objective of this course is to determine the reliability of the engineering systems encountered in industry.

MODULE-1
UNIT-1   **6L+6T+0P=12 Hours**
Introduction: Terminology of Reliability, Types and Causes of Failures, Bath – tub curve, Failure Distributions – Binomial, Poisson, Exponential, Normal, Log – Normal, Weibull; Failure Data Analysis; Hazard Rate, Hazard Rate vs Failure Rate vs Reliability, Hazard Models – Constant, Linearly Increasing, Power Law, Gamma, Weibull; Reliability Estimation vs Reliability Prediction.

UNIT-2   **10L+10T+0P=20 Hours**
System Reliability: Part Stress Method, Part Count Method, Series Configuration, Parallel Configuration, Mixed Configuration, Stand – by Model, *k -out of – m* systems.

PRACTICES:
➢ Reliability Prediction for a given failure rate or hazard rate.
➢ Reliability Computation for Series, Parallel and Mixed Configurations.

MODULE-2
UNIT-1   **6L+6T+0P=12 Hours**
Multi - State Systems: Markov process, Markov – Chain, Reliability of Two – state systems following constant Hazard rate and Repair rate.

UNIT-2   **10L+10T+0P=20 Hours**
Interference Theory: General Expression for Reliability, Reliability Computation – Normally distributed Stress and Strength, Log - Normally distributed Stress and Strength, Exponentially distributed Stress and Strength; Normally Distributed Stress and Exponentially Distributed Strength and vice versa, Graphical Method.

PRACTICES:
➢ Reliability Estimation of Multi-state systems using Markov Model.
➢ Reliability Estimation using Stress–Strength Interference Method.

SKILLS:
➢ Failure data analysis
➢ Hazard Estimation
➢ Reliability Prediction and Estimation
➢ Prediction of reliability for a given failure rate or hazard rate.
➢ Reliability Computation for Series Configurations.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	**Estimate** the Reliability for a specified failure rate or hazard rate.	Apply	1	1, 2, 9, 11
2	**Demonstrate** the Reliability of multi – state systems.	Analyze	2	1,2,9
3	**Predict** the Reliability for a given system configuration.	Evaluate	1	1, 2,9, 11
4	**Propose** the expected Reliability for randomly distributed Stress and Strength of Components.	Create	2	1,2,9

TEXT BOOKS:
1. Charles E. Ebling, "An Introduction to Reliability and Maintainability Engineering", Tata Mc Graw Hill, Indian Edition**,** 2017.
2. Alessandro Birolini, "Reliability Engineering: Theory and Practice", Springer, 8th Edition, 2017.

REFERENCE BOOKS:
3. L. S. Srinath, "Reliability Engineering", East-West Press, 4th edition, 2016.
4. Elsayed A. Elsayed, "Reliability Engineering", Wiley, 2nd Edition, 2011.

Image source: https://www.scienceforsport.com/reliability/
Image file name: RELIABILITY ENGINEERING

22ME903-MAINTENANCE ENGINEERING

Hours per week:

PREREQUISITE KNOWLEDGE: Basics of Mathematics

L	T	P	C
3	2	0	4

COURSE DESCRIPTION AND OBJECTIVES

This course deals with the fundamental concepts, necessary knowledge and basic skills related to systems maintenance function and its models for optimal maintenance replacement schedules. The objective of this course is to interpret the maintenance principles, strategies and models for repairable systems in the real-world industry.

MODULE-I

UNIT-1   **6L+6T+0P=12 Hours**

Maintenance Philosophy: Objectives and principles of maintenance, Strategic, tactical and continuous improvements; Maintenance categories - Preventive maintenance, Total productive maintenance, Reliability centred maintenance.

Component Replacement Decisions: Introduction, Development of mathematical models for optimal replacement times of equipment based on maintenance and equipment cost, equipment subjected to break down.

UNIT-2   **10L+10T+0P=20 Hours**

Maintenance Philosophy: Manufacturing Industry, Processing Industry, Transport systems, Mining equipment, Automobiles and Material handling equipment.

PRACTICES:

➢ Optimal replacement time for the air filter in an automobile based on cost minimization.
➢ Optimal preventive replacement interval of a Left-Hand Steering Clutch subject to breakdown.

MODULE-2

UNIT-1   **6L+6T+0P=12 Hours**

Repairable System: Types of repairs - perfect, minimal and imperfect; Types of systems - independent identically distributed (i.i.d) and dependent. Reliability and Availability, MTBF, MTTR and MWT, Factors of Availability. Maintainability and its factors.

UNIT-2   **12L+8T+0P=20Hours**

Rams Analysis: Renewal process, Poisson process for i.i.d systems, Homogenous Poisson Process for a perfect repair, Non-homogenous process for minimal repair and Kijima-I and kijima-II models for imperfect repair, Expected number of failure estimation for each variety. RAMS analysis of aircraft fleet, railway fleet, Passenger buses fleet and Wind Turbine fleet.

PRACTICES:

➢ Evaluate the Reliability of domestic passenger buses used for public transport in the near city.
➢ Determine the Availability and Maintainability of diesel/electrical locomotives of Indian railways.

SKILLS:

➢ Acquire the knowledge of principles of maintenance, statistics and optimal models to work professionally in industrial systems.

- ➢ Maintenance workload analysis and scheduling.
- ➢ Prepare maintenance resource planning.
- ➢ Computerized maintenance management systems (CMMS).
- ➢ Prepare the maintenance schedule for mining trucks.
- ➢ Apply the RAMS analysis to the wind power plant.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of maintenance engineering to work professionally in industrial systems.	Apply	1	1, 2, 9, 11
2	Estimate systems maintenance as well as related characteristics of repairable systems for better maintainability.	Evaluate	1	1, 2,9, 11
3	Discuss various condition monitoring techniques in preventive maintenance.	Analyze	2	1,2,9
4	Evaluate optimal maintenance times of an equipment for variety of maintenance conditions.	Evaluate	2	1,2,9

TEXT BOOKS:
1. Andrew K.S. Jardine and Albert H.C. Tsang, "Maintenance, Replacement, and Reliability:
2. Theory and Applications", CRC Press, 2nd Edition, 2013.
3. Elsayed A and Elsayed, "Reliability Engineering", John Wiley & Sons, 2nd Edition, 2012.

REFERENCES:
1. John D. Campbell, Andrew K.S. Jardine and Joel Mc Glynn, "Asset Management Excellence: Optimizing Equipment Life-Cycle Decisions", CRC Press, 2nd Edition, 2016.
2. B.S Dillon, "Engineering Maintenance: A modern approach", CRC Press, 1st Edition, 2002.
3. Dimitri B. Kececioglu, "Maintainability, Availability & Operational Readiness Engineering Handbook, Volume 1", DEStech Publications, 1st Edition, 2003.
4. Riccardo Manzini, Alberto Regattieri, Hoang Pham and Emilio Ferrari "Maintenance for Industrial Systems", Springer-Verlag London Limited, 2010.

File Source: https://limblecmms.com/blog/industrial-maintenance/#industrial-maintenance

File Name: MAINTENANCE ENGINEERING

22ME904-RELIABILITY ESTIMATION AND LIFE TESTING

Hours per week:

PREREQUISITE KNOWLEDGE: Basics of Probability and Statistics

L	T	P	C
3	2	0	4

COURSE DESCRIPTION AND OBJECTIVES
This course offers fundamentals of reliability estimation, life testing and goodness of fit for failure and maintenance data of industrial systems. The objective of this course is to impart knowledge on life testing techniques and methods to estimate the reliability of the components.

MODULE-1
UNIT-1   **6L+6T+0P=12 Hours**
RELIABILITY ESTIMATION METHODS:

Reliability Data Collection and Empirical Methods-Ungrouped Complete Data, Grouped Complete Data, Ungrouped Censored Data, Grouped Censored Data and Statistical life-estimation.

UNIT-2   **10L+10T+0P=20 Hours**
RELIABILITY ESTIMATION APPLICATIONS:
Reliability Estimation Applications- Redundancy test, Burn-In test, Reliability Allocation, Reliability Growth Test, Repairable System Analysis and Multi Censored Data.

PRACTICES:
➢ Reliability estimation of electronic components.
➢ Reliability allocation for the systems used in the processing industry.

MODULE-2
UNIT-1   **6L+6T+0P=12 Hours**
RELIABILITY LIFE TESTING:

Reliability Life Testing: Burn-in and screening testing, Sequential testing, Acceptance testing, accelerated life testing, Test time calculations, Identification of failure and repair distributions, **Goodness of Fit tests** - Chi-square goodness of fit test, Bartlett's test, Mann's test, Kolmogorov-Smirnov test and Cramer Von-Mises test.

UNIT-2   **10L+10T+0P=20 Hours**
CASE STUDIES ON RELIABILITY TESTING:

Reliability Testing of a light commercial vehicle manufacturing system, Modeling and analysis of Software system reliability, reliability assessment of composite materials, identification of critical components in complex engineering systems with test data.

PRACTICES:
- ➢ Accelerating life testing of electrical bulbs to evaluate the life of components.
- ➢ Life testing of composite materials used for aerospace application.

SKILLS:
- ➢ Know the life of the component.
- ➢ Identify the effects of environmental conditions on the life of systems.
- ➢ Recognize the suitable technique to estimate the reliability of components in a specific application.
- ➢ Apply the concept of the Non-parametric method to estimate the hazard rate for bearings
- ➢ Evaluate the life and warren of the electronic components

COURSE OUTCOMES:
Upon completion of the course, the student will be able to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Outline the concept of reliability estimation and apply the methods for systems.	Apply	1	1, 2, 3,5, 12
2	Apply the concept to estimate the reliability of industrial systems.	Apply	1, 2	1, 2, 3, 9
3	Analyze the method of sampling and solve problems.	Analyze	1, 2	1, 2, 3
4	Evaluate the life of components under environmental conditions.	Evaluate	2	1, 2, 9, 12
5	Apply the concept of Reliability for software testing.	Apply	1, 2	1, 2, 3, 4, 9, 12

TEXT BOOKS:
1. Elsayed A. Elsayed, Reliability Engineering, John Wiley, 2nd Edition, 2012
2. V. N. A. Naikan, Reliability Engineering and Life Testing, PHI, 5th Edition, 2019.

REFERENCES BOOKS:
1. E Balagurusamy, Reliability Engineering, Tata McGraw-Hill. 2nd Edition, 2011
2. Charles E. Ebeling, Reliability and Maintainability Engineering, Tata McGraw-Hill. 9th Edition, 2008
3. F. A. Tillman, C. V. Hwang & W. Kuo, Optimization of Systems Reliability, Marcel Dekker Inc.

Image Source: https://www.ansys.com/resource-center/case-study/accelerated-life-testing-test-plan development

Image Name: RELIABILITY ESTIMATION AND LIFE TESTING

22ME905-SAFETY ENGINEERING

PREREQUISITE KNOWLEDGE: Basics of Probability and Statistics

COURSE DESCRIPTION AND OBJECTIVES
This course offers fundamental of safety engineering and industrial
practices to apply the principles and approach of inherently safer design to reduce and eliminate
hazards and thereby lower the risk of new or currently operating systems.

Hours per week:			
L	T	P	C
3	2	0	4

MODULE- I

UNIT-1   **6L+6T+0P=12 Hours**
SAFETY REGULATIONS:

Laws and Regulations – Relevant Provisions of Factories Act and Rules, Indian. Electricity Act and Rules, Explosive Act and Rules, Gas Cylinders Rules.
Safety in Workplace – Plant / Work area Design – Hand tools and Portable power tools– Manual and Mechanical Material Handling – Ergonomics – Machine Guarding –Storage of Materials.

UNIT-2   **10L+10T+0P=20 Hours**
INDUSTRY PRACTICES ON SAFETY:

Electrical Safety – Safety in Electricity Industry – Types of Electrical Hazards – Energy Isolation–Industrial   case   studies.
Safety in Engineering Industry – Introduction – Safety in Operations of Hazardous Machines – Safety in welding and gas cutting – Safety in cold forming and hot working of metals – Work Permits for hot Work and Cold Work – Safety of Pressure vessels – Safety in inspection and testing – Safety in radiography. Industrial case studies.
Safety in Construction Industry – Scope of safety in construction – Safety in Construction and Demolition Operation.
Safety in Chemical Industries – Introduction – Bulk / Isolated storage – Pipeline Safety – Chemical Reaction, Processes and its Hazards.

PRACTICES:
➢ Prepare the safety audit case study for the chemical processing industry.
➢ Evaluate the safety parameters of the Missile.

MODULE-2

UNIT-1   **6L+6T+0P=12 Hours**
Safety Evaluation Techniques: Evaluation of modern safety concept, safety policy, Safety Organization. Techniques- Incident Recall Technique (IRT) disaster control, Job Safety Analysis (JSA), Safety survey, Safety Audit.

UNIT-2   **10L+10T+0P=20 Hours**
SAFETY PERFORMANCE MONITORING
Safety Performance Monitoring - Reactive and monitoring techniques, permanent total disabilities, permanent partial disabilities, temporary total disabilities, Calculation of accident

indices, frequency rate. Severity rate, frequency severity incidence, incident rate, accident rate, and safety activity rate. Case studies in software safety.

PRACTICES:
➢ Evaluate the safety of the pharmaceutical industry using JSA.
➢ Calculation of accident indices in Nuclear power plant.

SKILLS:
➢ Assessment of heat stress in the work environment.
➢ Measurement of sound levels.
➢ Measurement of vibrations of machines and equipment.
➢ Measurement of software safety performance.
➢ Identifying and making amendments to the potential hazards on facilities, machinery and the safety systems.
➢ Evaluating the efficiency of various industrial machinery with safety regulations.

COURSE OUTCOMES:
Upon completion of the course, the student will be able to

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Outline the need for safety in an organization and apply it in the industry.	Apply	1	1, 6, 7, 8
2	Evaluate the safety aspects and its recording techniques in industries.	Evaluate	1, 2	1, 2, 6, 8
3	Evaluate the industrial software safety performances.	Evaluate	2	1, 6, 7, 8
4	Create awareness of safety techniques and implement them in the organization.	Create	1, 2	1, 6, 8

TEXT BOOKS:
1. L M Deshmukh, "Industrial safety management", TATA McGraw Hill, 4th Edition, 2015
2. N.V. Krishnan, "Safety in Industry" Jaico Publisher House, 10th Edition, 2020

REFERENCES BOOKS:
1. A. K Gupta, "Reliability, Maintenance and Safety Engineering", 1st Edition, 2015
2. Willie Hammer, "Occupational safety management and engineering", Prentice Hall, 3rd Edition, 2012
3. R.K Mishra, "Construction Safety", Aitbs Publishers, 2nd Edition, 2013.

Image Source: https://greenwgroup.co.in/industrial-safety/
Image Name: SAFETY ENGINEERING

MINOR ON UNMANNED AERIAL VEHICLES
Offered by Department of Mechanical Engineering

The prospects for the drone market look promising, with some estimates indicating that **the global drone market is poised to grow by $21.01-billion from 2021 to 2025**, progressing at a compound annual growth rate of 14.42% during the forecast period. According to an estimate by India's civil aviation ministry, **the country's drone sector is estimated to swell to $2 billion by 2026**, as UAVs are being adopted by sectors as diverse as agriculture, defense, law enforcement, transportation, and surveillance.

Technologies related to UAV (unmanned aerial vehicle) are developing rapidly. On the other hand, technologies related to farming are developing also, and several possibly revolutionizing technologies are about to become reality in farming. These technologies can set new goals and targets for the UAV imaging in smart farming. This work first reviews forthcoming technologies from measurement technologies, data management, execution technologies, and farming methods and then, as a top-down basis, formed possible imaging concepts for the future. The core future concepts were new imaging techniques with UAVs, data collection for digital twins and mapping for on-demand acting working UAVs and robotics. The presented technologies are at very early development stage.

"Your Wings Already Exists, all you have to do is Fly"
https://www.uandimproved.com/top-motivational-quotes/

We at VFSTR offering this as a Minor Degree which helps the students to acquire basic knowledge about the design, operation, control and data analysis from the sensors mounted on UAVs based on the end application through the courses offered in this minor.

UAV Technical Knowledge is a requisite for the following job roles:
- **Drone pilots.**
- **Design engineers and assemblers.**
- **Pilot trainers.**
- **Drone flight planners.**
- **Drone software engineers.**
- **Drone Data Specialists.**

Course Code	Course Title	L	T	P	C
22ME906	Aerodynamics	3	2	0	4
22ME907	Basics of UAV's	3	2	0	4
22ME908	Data Acquisition In UAV's	3	2	0	4
22ME909	Trouble Shooting Of UAV's	3	2	0	4
22ME910	UAV Dynamics And Control	3	2	0	4

21ME906-AERODYNAMICS

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of physics, applied mathematics of dynamics.

COURSE DESCRIPTION AND OBJECTIVES

To introduce the students about basics airplane and concepts of aerodynamics and to familiarize the concepts of aircraft performance and various stability and control aspects of an airplane. To give knowledge about the basics of aircraft structures and materials. To make the students understand the principle and operation of propulsive unit of an airplane.

MODULE-1

UNIT-1   **6L+6T+0P=12 Hours**

Potential Flows: Governing equation for inviscid incompressible fluid flows, Bernoulli's equation, stream function, velocity potential, streamline, equipotential line, circulation, vorticity, rotational &irrotational flows. Elementary flows, combinations of elementary flows, ideal flow and lifting flow over a circular cylinder, KuttaJoukowski theorem, real flow over smooth and rough cylinders

UNIT-2   **10L+10T+0P=20 Hours**

Compressible Flows: Compressibility concepts, speed of sound & Mach number, one-dimensional steady flows: conservation equations, isentropic flow relations, normal shock relations. Oblique shock relations, Prandtl-Meyer flow, method of characteristics, shock-expansion theory. Small perturbation velocity potential equation: Prandtl-Glauert transformation-subsonic, linearized supersonic flow solution.

MODULE-2

UNIT-I   **6L+6T+0P=12 Hours**

Compressible& Incompressible Flows Over Airfoils and Wings: Airfoil nomenclature / characteristics, Kutta condition, circulation and lift, thin airfoil theory. Incompressible flow over finite wings: downwash, induced drag, Biot-Savart law, horse shoe vortex, Prandtl's lifting line theory, lift & induced drag for elliptic lift distribution.

Critical & drag divergence Mach numbers, Prandtl- Glauert compressibility correction, aerodynamic characteristics of supersonic airfoils, swept wings, effect of thickness / camber / AR, transonic area rule.

UNIT–2   **10L+10T+0P=20 Hours**

Boundary Layer Flows: Boundary layer properties, boundary layer equations, flow separation, incompressible flow over flat plate-Blassius solutions, free shear layers, approximate integral method-momentum integral relation, physical & mathematical description of turbulence, Reynolds equations of turbulent motion, two-dimensional turbulent boundary layer equation, velocity profiles, turbulent boundary layer over a flat plate, turbulence modeling. Compressible boundary layer velocity profiles: law of the wall, law of the wake, flat plate flow.

PRACTICES:
- Basic force concepts: resultant, equilibrant, moment and couple.
- Lami's theorem and the laws of mechanics to predict the stability of a structure.
- Force required to overcome friction.
- Position of the centroid of composite shapes and C.G. of rigid bodies.

SKILLS:
- ➢ Able to apply the basics of flow lines for the given profile
- ➢ Able to analyze the performance of the structure
- ➢ Able to stabilize the uncertain conditions.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the basic components and their functions.	Apply	1	1, 2
2	Identify various constructions of aircraft structure and the materials used for it.	Apply	2	1, 2,9
3	Get exposed about the stability and control aspects of an airplane.	Analyze	2	1, 2, 3
4	Evaluate the various performance measures of an airplane.	Evaluate	1	1, 2, 3

TEXT BOOKS:
1. John D. Anderson, Jr., Fundamentals of Aerodynamics, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1st Edition, 2007.
2. Schlitching, H., Boundary layer theory, Springer Verlag, Indian Reprint, 8th Edition, 2014.

REFERENCE BOOKS:
1. Liepmann, H. W and Roshko, A., Elements of Gas dynamics, Dover Publication, 1st Edition, 2002.
2. Houghton, E.L and Carpenter, P.W., Aerodynamics for Engineering Students, Elsevier, New Delhi, 1st Edition, 2005.
3. John D. Anderson Jr., Modern compressible flow-with historical perspective, McGraw-Hill Book Co., New York, 1st Edition ,2003.

Image source: https://www.poweruptoys.com/blogs/news/the-basic-principles-of-aerodynamics
Image file name: AERODYNAMICS

21ME907-BASICS OF UAV's

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Fundamental physics, Mathematics

COURSE DESCRIPTION AND OBJECTIVES
The course deals with the fundamentals of unmanned aerial vehicles, concept of pay load on the vehicles for several applications in defense, agricultural etc., basics related to launching and navigation of the vehicles. The objective of the course is to acquire the knowledge of basic UAV systems and ground control station to launch and navigate them.

MODULE-1

UNIT-I   **6L+6T+0P=12 Hours**
Introduction to UAV: Difference between aircraft and UAV - Parts and functions of Fixed, Rotorcraft and flapping wing UAV, types of UAV, payloads on UAV, Characteristics of Multi rotor vehicle, Fixed Wing vehicle, Flapping wing Vehicles and their applications.

UNIT-II   **10L+10T+0P=20 Hours**
Payloads For UAV: Payloads – Classification of Payloads – camera – sensors – radars – various measuring devices – classification of payload based on applications.

MODULE-II

UNIT-I   **6L+6T+0P=12 Hours**
Launch, Navigation & Recovery: Launching systems - UAV Launch Methods for Fixed-Wing Vehicles - Vertical Takeoff and Landing UAV Launch - Recovery systems.

UNIT-II   **10L+10T+0P=20 Hours**
UAV Systems & Ground Control Station: Navigation - UAV Guidance - communication systems - Ground control station – Telemetry - UAS future.

PRACTICES:
- Forces and moment estimation of fixed wing vehicle using sub sonic wind tunnels.
- Pressure distribution measurement over various airfoil sections.
- Thrust calculations for various types of propellers.
- Construction of various fixed wings – straight and dihedral.
- Design of Co-axial multirotor systems.

SKILLS:
- Able to estimate payload of the UAV configuration.
- Able to recover from the malfunctioning.
- Able to system ready for launch of UAV.

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	**Apply** the basic concepts of UAV systems.	Apply	1	1, 2
2	**Interpret** the data during launching, navigating, and recovery of UAV systems.	Apply	2	1, 2,9
3	**Estimate** the payloads on different vehicles.	Analyze	2	1, 2, 3
4	**Explain** the basic aerodynamics, performance, stability and control required for UAV.	Evaluate	1	1, 2, 3

TEXT BOOKS:
1. Paul Gerin Fahlstrom, Thomas J. Gleason, Introduction to UAV systems, Wiley Publication, 4th Edition, 2012.
2. Landen rosen, Unmanned Aerial vehicle, Alpha editions, ISBN13: 9789385505034.

REFERENCE BOOKS:
1. Valavanis, Kimon P., Unmanned Aerial Vehicles, Springer, 1st Edotopm. 2011.
2. Unmanned Aerial Vehicles: DOD's Acquisition Efforts, Alpha Editions, ISBN13:9781297017544.
3. Valavanis, K., Vachtsevanos, George J., Handbook of Unmanned Aerial Vehicles, Springer, 1st Edition, 2015.

Image source: http://www.culvercitypd.org/files/assets/police/images/showimages-6.jpeg?dimension=pageimage&w=480
Image file name: Basics of Unmanned Aerial Vehicles

21ME908-DATA ACQUISITION IN UAV's

PREREQUISITE KNOWLEDGE: Digital Fundamentals.

COURSE DESCRIPTION AND OBJECTIVES
To introduce students to fundamental data acquisition principles, concepts and methods. In addition, students will study and apply related software and hardware involved in acquiring data from sensors for measurement purposes.

MODULE-1
UNIT-1   **6L+6T+0P=12 Hours**
Introduction To Flight Testing And Flight Instrumentation: Introduction – Need for flight testing – Types of flight Testing – Aircraft conventional instruments - Data Acquisition.

UNIT-2   **10L+10T+0P=20 Hours**
Data Analysis: Filtering and Estimation – Introduction to Optimization - Least squares method – Maximum likelihood method - Gauss Newton Algorithm – Gradient decent method – Multiple Shooting method.

MODULE-2
UNIT-I   **6L+6T+0P=12 Hours**
System Modelling, Sensors & Calibrations: Aircraft modelling - Air data boom – Vane sensor – Potentiometer – Pressure transducer – Inertial measurement unit – fixing, Calibration and corrections.

UNIT–2   **10L+10T+0P=20 Hours**
Data Gathering and Compatibility Checks: Flight testing maneuvers – Data compatibility check – Flight path reconstruction techniques.
Flight Testing: Drag polar estimation – Climb performance evaluation – Determination of Stick free, stick fixed neutral points and maneuver point – Parameter estimation – Hazardous flight tests – Stall test – Spin test – Dive test.

PRACTICES:
- Study of conventional models.
- Modernization of standard functional parts.
- Analyzing the test cases.

SKILLS:
➢ Able to apply the testing methods of flight model.
➢ Able to calibrate the transformation model.
➢ Able to estimate the compatibility check up.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	**Apply** the basic concepts of flight testing.	Applying	1	1, 2
2	**Estimate** and optimize the data.	Evaluating	1	1, 2, 3
3	**Create** system models and calibration.	Creating	2	1, 2, 3
4	**Interpret** the compatibility checks.	Applying	2	1, 2,9

TEXT BOOKS:
1. Ralph D. Kimberlin, University Of Tennessee Sp R. Kimberlin "Flight Testing of Fixed-Wing Aircraft" (AIAA Education).
2. V. Jategaonkar, "FlightVehicle System Identification: ATime Domain Methodology" AIAA.

REFERENCE BOOKS:
1. Ralph D. Kimberlin, University Of Tennessee Sp R. Kimberlin "Flight Testing of Fixed-Wing Aircraft" (AIAA Education).
2. V. Jategaonkar, "FlightVehicle System Identification: ATime Domain Methodology" AIAA.

Image source: https://www.mccdaq.com/data-acquisition
Image file name: DATA ACQUISITION SYSTEMS

21ME909-ROUBLE SHOOTING OF UAV's

Hours per week:

PREREQUISITE KNOWLEDGE: Basics of physics

L	T	P	C
3	2	0	4

COURSE DESCRIPTION AND OBJECTIVES
To expose students to the concept of flight testing and the concepts of data acquisition systems. With the help of DAQ systems condition monitoring and maintenance activities are described.

MODULE-1

UNIT-1   **6L+6T+0P=12 Hours**
Introduction to Inspection & Maintenance Tools: Inspection – Types of Inspections – Dye Penetrant Inspection, Eddy Current Inspection, Ultrasonic Inspection, Magnetic Particle Inspection, X-Ray – Equipment's used in Welding Shop – Forming Tools - Riveting Tools.

UNIT-2   **10L+10T+0P=20 Hours**
Aircraft Structural Inspections &Air Frame Repairs: Inspection of Damage – Types of Damages and Defects – Classification of Damage – Inspection Openings.
Forming Process - Installation of Rivets – Riveting Procedure – Welding – Soldering and Brazing – Repair of Composite Components.

MODULE-2

UNIT-I   **6L+6T+0P=12 Hours**
Engine Component Inspections: Inspection of engine components – Daily and routine checks – Compression testing of cylinders in piston engine – Special inspection procedures: Foreign Object Damage – Blade damage – etc. Maintenance of gas turbine engines.

UNIT–2   **10L+10T+0P=20 Hours**
Overhaul of Engines: Symptoms of failure - Engine Overhaul procedures – Inspections and cleaning of components – Repairs schedules for overhaul – Engine Testing - Trouble Shooting – Condition monitoring of the engine on ground and at altitude – Engine Health Monitoring and corrective methods.

PRACTICES:
➢ General inspection.
➢ Frame structures and modelling.
➢ Object faulty identification.
➢ Condition monitoring & maintenance.

SKILLS:
➢ Able to determine the malfunction unit.
➢ Able to rectify the problem caused by the faulty unit.
➢ Able to trouble shoot the complex tedious task.

COURSE OUTCOMES:
Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify the malfunction device.	Applying	1	1, 2
2	Estimate the time required to pair the task.	Evaluating	1	1, 2, 3

| 3 | Apply the functional knowledge. | Applying | 2 | 1, 2, 3 |
| 4 | Assemble and run the system. | Applying | 2 | 1, 2,9 |

TEXT BOOKS:
1. Rogelio Lozano, Unmanned Aerial Vehicles: Embedded Control, Wiley-ISTE, 1ˢᵗ Edition, 2010.
2. Fahlstrom, "Introduction To UAV Systems"4E" Wiley Publisher, 1ˢᵗ Edition, 2016.

REFERENCE BOOKS:
1. "Aviation Maintenance Technician Handbook – Airframe, Volume – I", Federal Aviation Administration.
2. "Aviation Maintenance Technician Handbook – Powerplant, Volume – II", Federal Aviation Administration.

Image source: https://uavcoach.com/how-to-fly-a-quadcopter-guide/
Image file name: ROUBLE SHOOTING OF UAVs

21ME910-UAV DYNAMICS AND CONTROL

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of forward dynamics and kinematics

COURSE DESCRIPTION AND OBJECTIVES

This course introduces students to the analysis and control of unmanned aerial vehicles (UAVs). The course will cover modeling and dynamics of aerial vehicles, and common control strategies that allow students to apply knowledge on a real system, by programming a microcontroller to control a UAV.

MODULE-1

UNIT-1   **6L+6T+0P=12 Hours**
rigid Body Dynamics: Equilibrium, Degrees of Freedom, Planar kinematics of rigid bodies, angular velocity, angular acceleration in three dimensions, Moment of Inertia and Mass Moment of Inertia, Inertia Properties, D'Alembert's Principle, Holonomic and non holonomic constraints. Multi-body dynamic analysis of simulation software.

UNIT-2   **10L+10T+0P=20 Hours**
Co-Ordinate Frames and Transformations: Co-ordinate frames, Euler angles and fixed angles representation, Quarternion, Direction cosine matrix, Mapping of Co-ordinate frames, Linear Transformations, Rigid-Body Rotations Homogeneous coordinate transformations, Assignment of coordinate systems and derivation of transformation matrices.

MODULE-2

UNIT-I   **6L+6T+0P=12 Hours**
Uav Dynamics and Analysis: Linear and rotational velocity of rigid bodies, Newton-Euler, Lagrangian formulation, closed form solutions, Equations of Motion: Quad Rotor Dynamics, Flapping Wing Vehicle Dynamics and Fixed Wing Vehicle Dynamics, State Space.

UNIT–2   **10L+10T+0P=20 Hours**
Introduction To Control: Taylor Series Linearization, Linear Control – Controllability and observability, Feedbackcontrol – PID, LQR, LQG, Pole Placement technique, Lyapunov stability Design of control algorithm and simulation using MATLAB.
Altitude and Attitude Control of UAVs – Fixed and Rotary wing vehicles – Directional Control of Flapping wing vehicles.

PRACTICES:
- Quad rotor dynamics estimation.
- Determination of state space for the given model.
- Fixed and rotary wings stress analysis and thrust safety estimation.

SKILLS:
- ➢ Able to perform transformations of the frames.
- ➢ Able to apply forward dynamics to the given system of forces.
- ➢ Able to use the microcontroller and compile it.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse the dominant effects acting on a UAV.	Analysing	1	1,2
2	explain and derive dynamic relationships governing UAV flight.	Applying	1	1,2
3	Evaluate different dynamics and analysis.	Evaluating	2	1,2,3
4	implement a controller, compile & flash code to a microcontroller.	creating	2	1,2,9

TEXT BOOKS:

1. Rogelio Lozano, Unmanned Aerial Vehicles: Embedded Control, Wiley-ISTE, 1st Edition, 2010.
2. KenzoNonami , FaridKendoul, Satoshi Suzuki , Wei Wang, Daisuke Nakazawa, Autonomous Flying Robots: Unmanned Aerial Vehicles and Micro Aerial Vehicles, Springer, 1st Edition, 2010.

REFERENCE BOOKS:

1. Rogelio Lozano, Unmanned Aerial Vehicles: Embedded Control, Wiley-ISTE, 1st Edition, 2010.
2. KenzoNonami , Autonomous Flying Robots: Unmanned Aerial Vehicles and Micro Aerial Vehicles, Springer, 1st Edition, 2010.
3. Stevens, B. L. and Lewis, F. L., Aircraft Control and Simulation, Second Edition, John Wiley and Sons, Inc., Hoboken, New Jersey, 1st Edition, .2003.

Image source: https://www.mdpi.com/2504-446X/4/4/71

Image file name: UAV DYNAMICS AND CONTROL

MINOR ON NATIONAL CADET CORPS

Offered by National Cadet Corps

National Cadet Corps, as minor elective develops character, comradeship, discipline, leadership, secular outlook, spirit of adventure, sportsmanship, and ideals of selfless service among the youth of the country. It creates a human resource of organized, trained, and motivated youth, to provide leadership in all walks of life and always be available for the service of the nation. It also provides a suitable environment to motivate the youth to take up a career in the Armed Forces.

Cadet will be trained during 2-2, 3-1, 3-2, 4-1 and 4-2 for fulfilling 'B' and 'C' certificate during the course, and can avail various incentives from center and state Govts as under

- ➢ Vacancies reserved for commission in Defence Forces for NCC `C' Certificate:
    - o Army 64 per year- Indian Military Academy (IMA), Dehradun through UPSC and Service Selection Board (SSB) Interview.
    - o 100 per year - in Officers Training Academy (OTA), Chennai for Short Service Commission
    - o Non Technical - No UPSC Exam, only SSB.
    - o Navy -6 per Course. No UPSC Exam, Only Naval SSB.
    - o IAF – 10 % in all courses including Flying Training courses. No UPSC Exam only Air Force SSB.
- ➢ For ORs, Sailors, Airmen: 5 to 10% bonus marks awarded for recruitment.
- ➢ Para Military Forces: 2 to 10 bonus marks awarded for recruitment.
- ➢ Department of Telecommunication: Bonus marks awarded for recruitment.
- ➢ CRPF NCC Cadets holding third division degree eligible for recruitment to gazette post.
- ➢ National Cadet Corps Civilian Gliding Instructors / Girl Cadet Instructors and NCC WTLOs.
- ➢ State Governments Preference in State Services in certain States.
- ➢ Industry Some Industries give preference to NCC 'C' Certificate holders for various jobs.

Cadets will get special SSB Training during 4-1 and 4-2 Semester. The following are the details of courses.

Course Code	Course Title	L	T	P	C
22NC901	National Cadet Corps - I	2	0	4	4
22NC902	National Cadet Corps - II	2	0	4	4
22NC903	National Cadet Corps - III	3	0	2	4
22NC904	Service Selection Board - I	3	0	2	4
22NC905	Service Selection Board - II	3	0	2	4

22NC901 - NATIONAL CADET CORPS - I

Hours per week:

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces NCC and its History, Aims and Objectives of NCC, Advantages of NCC, Personality Development and Leadership Skills.

MODULE-1

UNIT-1   **8L+0T+16P=24 Hours**

NCC GENERAL-I:

Introduction of NCC, History, Aims, Objective of NCC & NCC as Organization

UNIT-2   **8L+0T+16P=24 Hours**

NCC GENERAL-II:

Incentives of NCC, Duties of NCC Cadet. NCC Camps: Types & Conduct.

PRACTICES:

Drill:

- Aam Hidayaten
- Word of Command
- Savdhan
- Vishram
- Aram Se Murdna
- Kadvar Sizing
- Teen Line Banana
- Khuli Line
- Nikat Line
- Khade Khade Salute Karna
- Visarjan
- Line Tod
- Tej Chal
- Tham
- Dhire ChalTham

MODULE-2

UNIT-1   **8L+0T+16P=24 Hours**

PERSONALITY DEVELOPMENT:

Communication skills, Intra & Interpersonal skills - Self- Awareness & Analysis, Empathy, Emotional Intelligence, Critical & creative thinking, Decision making and problem solving.

UNIT-2   **8L+0T+16P=24 Hours**

LEADERSHIP:

Leadership capsule. Important Leadership - traits, Indicators, and evaluation. Motivation-Meaning & concept, Types & Factors of affecting motivation. Ethics and Honor codes.

PRACTICES:

Drill:
- Foot Drill Dahine
- Baen, Aage aur Piche Kadam Lena
- Tej Chal se Murdna
- Tej Chal se Salute KarnaTej Kadam Taal aur Tham
- Tej Kadam Taal se Kadam Badalna
- Teeno Teen se Ek File aur ek file se Teeno Teen Banana.
- Personality development activities
- Leadership activities

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	**Enhances** self-awareness and confidence by being honest about who you are and what drives you to gain confidence, self-esteem	Apply	1	7, 8, 9, 10, 12
2	**Recognizes the need** of vision, communication, Decision making, guidance and commitment etc.,	Apply	1	7, 8, 9, 10, 12
3	**Analyze** one's own principles and views and show a willingness to review and reevaluate them. unique characteristics and traits, physical and mental strength	Analyze	2	7, 8, 9, 10, 12
4	**Analyze** learned skills, to acquire a solid grasp of and commitment to accountability on a personal and professional level.	Analyze	2	7, 8, 9, 10, 12

TEXT BOOKS:

1. National Cadet Corps Red Book (redbook26-5-2017.pmd(s3waas.gov.in))
2. Cadet Handbook - General (Ncc-CadetHandbook.pdf(nccorissa.org))
3. Cadet Handbook - Specialized (cadetHandBookSPLSUBJECTArmy.pdf(nccorissa.org))

Camp: Cadet Should attend Camp organized by NCC BN before end of the semester (Preferable in Holidays) for practical evaluation.

22NC902 - NATIONAL CADET CORPS-II

Hours per week:

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:

This course introduces about Civil Defence Organization, Emergencies, Management of activities during Emergencies etc. It also enlightens about various Weapons, Map Reading and FCBC.

MODULE-1

UNIT-1   **8L+0T+16P=24 Hours**

DISASTER MANAGEMENT 01:

Civil Defense Organization and NDMA, Types of Emergencies / Natural Disasters, Fire Services & Fire Fighting,

UNIT-2   **8L+0T+16P=24 Hours**

DISASTER MANAGEMENT 02:

Traffic Control During Disaster Under Police Supervision, Essential Services and their Maintenance, disaster management, Setting up of Relief Camp During Disaster Management, Collection & Distribution of Aid Material

PRACTICES:

Map Reading:

- Introduction to types of Maps
- Conventional Signs
- Scales and Grid System
- Topographical Forms
- Technical Terms
- Relief
- Contours
- Gradients
- Cardinal Points
- Types of North
- Types of Bearing
- use of Service Protractor
- Prismatic Compass and its use in
- GPS
- Map to Ground
- Ground to Map

MODULE-2

UNIT-1   **8L+0T+16P=24 Hours**

WEAPON TRAINING (WT):

Characteristics of .22 Rifle, Stripping, Assembling, Loading / Unloading and Bolt Manipulation, Lying Position and Hold, Aiming, Range and Targets, Trigger Control and Firing a Shot, Range Procedure and Safety Precautions, Characteristics of 7.62mm SLR and 5.56mm INSAS, Characteristics of 7.62mm SLR, Ammunition, Firepower, Stripping Assembling and Cleaning, Characteristics of 5.56mm INSAS Rifle, Ammunition, Firepower Stripping Assembling and Cleaning, Firing .22 Rifle

UNIT-2   **8L+0T+16P=24 Hours**

FIELD CRAFT & BATTLE CRAFT: Introduction to Field Craft and Battle Craft, Judging Distance, Description of Ground, Recognition Description, indication of landmark and target, Observation, Camouflage and concealment, Field Signals, Section Formations, Fire Control Orders, Fire & Movement, Knots & Lashing.

PRACTICES:

 Weapon Training activities:
- Stripping
- Assembling,
- Loading / Unloading and Bolt Manipulation

- Lying Position and Hold
- Aiming
- Range and Targets
- Trigger Control and Firing a Shot

 Field Craft and Battle Craft activities:
- Judging Distance
- Description of Ground
- Recognition Description
- indication of landmark and target
- Observation
- Camouflage and concealment

- Field Signals
- Section Formations
- Fire Control Orders
- Fire & Movement
- Knots & Lashing.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	**Able to know** of various weapons, their properties and handles Weapons	Apply	1	7, 8, 9, 10, 12
2	**Able to know** Civil defense and its organization	Apply	1	7, 8, 9, 10, 12
3	**Make use of** prismatic compass, Service protractor to know ones own position	Analyze	2	7, 8, 9, 10, 12
4	**Application of** map reading from ground to map and map to ground	Analyze	2	7, 8, 9, 10, 12

TEXT BOOKS:

1. National Cadet Corps Red Book (redbook26-5-2017.pmd(s3waas.gov.in))
2. Cadet Handbook - General (Ncc-CadetHandbook.pdf(nccorissa.org))
3. Cadet Handbook - Specialized (cadetHandBookSPLSUBJECTArmy.pdf(nccorissa.org))

Image Source:

Camp: Cadet Should attend Camp organized by NCC BN before end of the semester (Preferable in Holidays) :

<div align="center">**22NC903- NATIONAL CADET CORPS-III**</div>

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:
This course introduces about Armed Forces, Various Social Service Activities, General awareness about resources management and National Integration.

<div align="center">**MODULE-1**</div>

UNIT-1   **12L+0T+8P=20 Hours**
ARMED FORCES & MILITARY HISTORY:
Armed Forces: Basic Organization, Organization of Army, Badges and Ranks, Task and Role of Supporting Arms and Services, Modes   of entry   to Armed Forces, Honors and Awards, Infantry Weapons
Military History: Biographies of renowned Generals, Indian Army War Heroes: PVC, Study of Battles of Indo-Pak Wars 1965, 1971 & Kargil, War Movies.

UNIT-2   **12L+0T+8P=20 Hours**
SOCIAL SERVICE & COMMUNITY DEVELOPMENT:
Social Service & Community Development: Social service and need, Types, activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare.

PRACTICES:
Social Service & Community Development Activities:
- Fundraising for support of NGO's instead of birthday or festival gifts
- Volunteering in conduction of Blood Donation Camps
- Conduction of elocution, debates on child abuse / trafficking
- Participate in a charity walk or run
- Participate in a national giving or Remembrance Day
- Clean up your university playground or department surrounding

<div align="center">**MODULE-2**</div>

UNIT-1   **12L+0T+8P=20 Hours**
GENERAL AWARENESS: Natural Resources - Conservation and Management, Water Conservation and Rainwater Harvesting, Waste Management, Pollution Control - Water, Air, Noise and Soil, Energy Conservation, Wildlife Conservation & Projects in India.

UNIT-2   **12L+0T+8P=20 Hours**
NATIONAL INTEGRATION: Importance, Necessity, & Factors affecting, Unity in Diversity & Role of NCC in Nation Building, Threats to National Security.

PRACTICES:

Social Service & Community Development Activities:

- Organizing Swachhata Melas
- Exhibition on local waste management technologies.
- Make wall paintings in public places (Panchayat offices, etc.) on the theme of a clean village, promotion of compost pits, and proper management of plastic waste
- Organizing plastic–free village campaigns and declaring of plastic-free zones.
- Organizing segregation of waste as biodegradable and non-biodegradable

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	**Able to know** about natural resources and their management, different freedom movements and their specific objective of each.	Apply	1	7, 8, 9, 10, 12
2	**Able to know**, the importance of the socio-cultural fabric of the country, the spirit of unity in diversity. Understanding the need for revival of the spirit of oneness and brotherhood to build a sovereign nation.	Apply	1	7, 8, 9, 10, 12
3	**Application** of learned technology for conservation and management of resources	Analyze	2	7, 8, 9, 10, 12
4	**Able to know** social services and its need in the development of the society for strong value system and **Make use of** voluntary organization to serve the local society that transforms to responsible citizens.	Analyze	2	7, 8, 9, 10, 12

TEXT BOOKS:

1. National Cadet Corps Red Book (redbook26-5-2017.pmd(s3waas.gov.in)
2. Cadet Handbook - General (Ncc-CadetHandbook.pdf(nccorissa.org))
3. Cadet Handbook - Specialized (cadetHandBookSPLSUBJECTArmy.pdf(nccorissa.org))

Image Source:

Hours per week:

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:
This course strengthens candidate's mental and physical capacities such that they ready for the job role of the Indian Armed Forces. It also exposes the detailing of Human body and how to prevent various infections / diseases. It also various communication devices used in Indian Army.

MODULE-1
UNIT-1   **12L+0T+8P=20 Hours**
HEALTH & HYGIENE: Structure and function of the human body, Hygiene and sanitation, Infectious and contagious diseases, and its Prevention.

UNIT-2   **12L+0T+8P=20 Hours**
COMMUNICATION-01: Types of Communications, Characteristics of Wireless, Characteristics of Walkie / Talkie.

PRACTICES:
Obstacle Training:
- Safety Measures
- Benefits
- Straight Balance
- Gate Vault,
- Zig-Zag Balance.

MODULE-2
UNIT-1   **12L+0T+8P=20 Hours**
COMMUNICATION-02: Basic Radio Telephony Procedure, Latest Trends and Developments (Multimedia, video conferencing, IT).

UNIT-2   **12L+0T+8P=20 Hours**
ADVENTURE: Mountaineering Expeditions, Trekking Expedition, Slithering, Para sailing, Cycle and Motorcycle Rallies.

PRACTICES:
Obstacle Training:
- High Wall
- Double Ditch.
- Right Hand Vault,
- Left Hand Vault, Ramp

Trekking Activities:
- Cyclothon for social awareness on various types of local problems
- Trekking at nearby place

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Able to know the knowledge about various communication devices used in war fields	Apply	1	7, 8, 9, 10, 12
2	Able to know the Structure and function of the human body, Hygiene and sanitation, Infectious and contagious diseases, and its Prevention.	Apply	1	7, 8, 9, 10, 12
3	Conducts various cycle rallies on social problems	Analyze	2	7, 8, 9, 10, 12
4	Conducts one Trekking	Analyze	2	7, 8, 9, 10, 12

TEXT BOOKS:

1. Commander RS Rathore (retd.), "Best Book on SSB interview", Jan 2022 edition
2. Cadet Handbook - General (Ncc-CadetHandbook.pdf(nccorissa.org))
3. Cadet Handbook - Specialized (cadetHandBookSPLSUBJECTArmy.pdf(nccorissa.org))

Image Source: https://images-na.ssl-images-amazon.com/images/I/81EtvmmFmSL.jpg
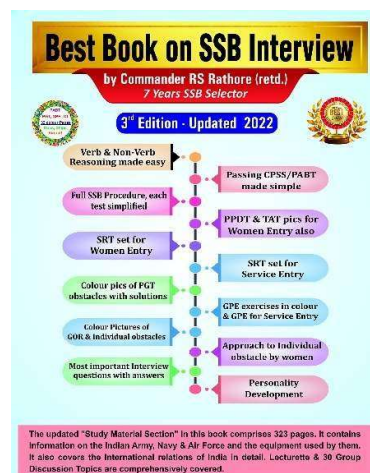
22NC905 - SERVICE SELECTION BOARD-2

Hours per week:			
L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Nil
COURSE DESCRIPTION AND OBJECTIVES:
This course strengthens candidates in Self-Description and Narrating skills based on image shown. It will train in Thematic, Word Association Test, Situation Reaction Test. This helps in how to behave in groups and manage people. It gives the knowledge how to get ready for SSB Interview.

MODULE-1

UNIT-1   **12L+0T+8P=20 Hours**

SSB PICTURE PERCEPTION AND DISCUSSION:

Write, Narrate, and then discuss a made-up story relative to an image shown

UNIT-2   **12L+0T+8P=20 Hours**
SSB PSYCHOLOGY: Thematic Appreciation Test, Word Association Test, Situation Reaction Test, Self-Description Test

PRACTICES:
- Picture Perception and Discussion Activities
- Psychology Activities

MODULE-2

UNIT-1   **12L+0T+8P=20 Hours**
SSB GROUP TESTING OFFICER (GTO):
Group Discussion (GD), GPE or MPE (group/military planning exercise), Progressive group task (PGT), Snake Race / Group Obstacle Race, Individual Lecturette (IO), Half Group Task (HGT), Individual Obstacles, Command task, Final Group Task (FGT).

UNIT-2   **12L+0T+8P=20 Hours**
SSB INTERVIEW:
Pre-Interview: Research about SSB and Job, Dress Code, Confidence building, Thought Process, Capability Analysis, FAQs (Behavioral, Stress Based).
During Interview: Interview etiquettes, Behavior
Post interview: Correspondence

PRACTICES:
- Group Testing Officer Activities
- Personal Interview Activities

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Able to improve Physical strength and Mental strength	Apply	1	7, 8, 9, 10, 12
2	Able to improve the presentation skills	Apply	1	7, 8, 9, 10, 12
3	Apply the abilities like time management, communication skills; Interview skills	Apply	2	7, 8, 9, 10, 12
4	Apply the learned group tasks in managing people in Professional life	Apply	2	7, 8, 9, 10, 12

TEXT BOOKS:

1. Commander RS Rathore (retd.), "Best Book on SSB interview", Jan 2022 edition
2. Cadet Handbook - General (Ncc-CadetHandbook.pdf(nccorissa.org))
3. Cadet Handbook - Specialized (cadetHandBookSPLSUBJECTArmy.pdf(nccorissa.org))

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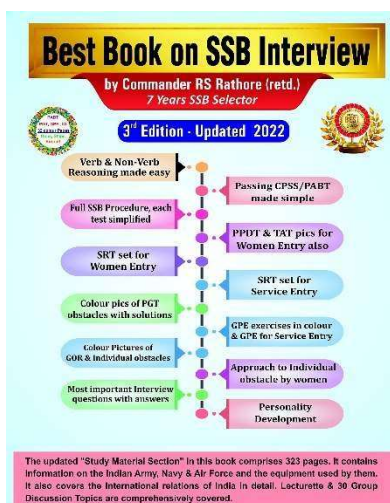
MINOR ON ROBOTICS ENGINEERING

Offered by Department of Robotics and Automation

Robotics and Automation Engineering is one of the emerging multi - disciplinary areas transforming conventional practices in industry to digitalization which plays a crucial role in the Prime Minister's Call 'MAKE IN INDIA', 'DIGITAL INDIA' and INDUSTRY 4.0.

Current status of Robotics

Robotics has already reached an advanced stage where crucial sectors, such as healthcare, are utilizing the technology to enhance their offerings. Robotic medical assistants are being used to constantly monitor and interpret the vital stats of patients. These revolutionary medical assistants are also capable of analyzing patient symptoms and designing a course of treatment. From dispensing drugs to conducting screening tests, robots can now share a lot of responsibilities with humans.

Robots are also replacing humans in warehouses where jobs are intensive and potentially dangerous. From heavy lifting to inventory collection, robots are capable of taking care of all warehousing tasks. According to the report 'Warehousing Market in India 2021', the industry which is valued at 1,050 billion in 2020 is expected to expand at a CAGR of 14.86 per cent between 2021 and 2025, taking the value to 2,028.86 billion by 2025. Driven by e-commerce and manufacturing sectors, 2021 witnessed about 4200 plus acres of manufacturing and warehousing land transactions. It can be expected that robotics will play a major role in the day to day operations of these warehouses.

"We're fascinated with robots because they are reflections of ourselves."-Ken Goldberg

The rapid transformation and advancement in the robotics sector in India come as a refreshing development in the technological landscape. The perfect amalgam of AI, Machine Learning and IoT, robotics will undeniably take on scores of jobs currently being tackled by humans. As far as the future of robotics in India is concerned, the picture looks bright and replete with potential.

VFSTR offering this as a Minor Degree which enable the students to acquire the knowledge of the Robot Anatomy, Operation, Control and automation of repetitive organizational tasks using robots based on the end application through the following courses:

Course Code	Course Title	L	T	P	C
22RA901	Fundamentals of Robotics	3	2	0	4
22RA902	Mobile Robotics	3	2	0	4
22RA903	Planning and Navigation	3	2	0	4
22RA904	Robotic Process Automation	3	2	0	4
22RA905	ROS Programming	3	2	0	4

22RA901-FUNDAMENTALS OF ROBOTICS

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Matrix Operations

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the basic concepts and topics to impart knowledge on Robots and their anatomy, kinematics, Dynamics and Applications. The main objective of this course is to make students familiarize about the concepts of Robotics as an introductory course.

MODULE-1

UNIT-1   **9L+6T+0P=15 Hours**

Robot Basics: Introduction, Robot Anatomy – Coordinate System, Matrix Transformations, Kinematic Analysis, Dynamic Analysis.

UNIT-2   **15L+10T+0P=25 Hours**

Kinematic and Dynamic Analysis of SCARA Robot, Articulated Arm, Parallel Manipulator.

PRACTICES:
- Jogging of Scara Robot.
- Jogging of Articulated Robot.
- Jogging of Parallel Manipulator.
- Motion Analysis of Robot using C/MATLAB.
- Evaluation of Joint angles of Robot by Inverse Kinematics using C/MATLAB.

MODULE-1

UNIT-1   **9L+6T+0P=15 Hours**

Robot Applications: Robot Cell Layouts, Multiple Robots and Machine Interference, Work Cell Control, Graphical Simulation of Robotic Work Cells, Economic Analysis.

UNIT-2   **15L+10T+0P=25 Hours**

Robot Cycle Time Analysis, Error Detection and Recovery, Payback Method, Equivalent Uniform Annual Cost Method, Return on Investment Method.

PRACTICES:
- Graphical Modeling of Single Robot Cell (ABB Studio).
- Graphical Modeling of Multi Robot Cell (ABB Studio).
- Graphical Simulation of Pick and Place Exercise using Multiple Robots (ABB Studio).
- Economic Analysis of Robot Cell using C/MATLAB.
- Error Detection and Recovery in Robot Cell using C/MATLAB.

COURSE OUTCOMES:

Upon successful completion of this course student will be able to:

No.	Course Outcome	Blooms Level	Module No.	PO
1	Distinguish robots based on their anatomy.	Apply	1	1,5,9,10,12
2	Perform kinematic and Dynamic analysis of robots.	Evaluate	1	1,2,3,5,9,10,12
3	Demonstrate the operation of grippers used in industries.	Analyze	2	1,2,4,5,9,10,12
4	Recommend type of robot based on end application.	Apply	2	1,5,9,10,11,12

SKILLS:
- Explain the basics involved in robots.
- Apply matrix transformation analysis for kinematic modeling.
- Suggest suitable type of robot based on end application.

TEXT BOOKS:
1. Peter Corke,"Robotics and Control: Fundamental Algorithms in MATLAB", Springer, 2nd Edition, 2021.
2. Nicolas Odrey, Mitchell Weiss, Mikell Groover, Roger Nagel, Ashish Dutta, "Industrial Robotics -Technology, Programming and Applications", McGraw Hill Publications, 2nd Edition, 2017.

REFERENCE BOOKS:
1. Laura Menini, Corrado Possieri, Antonio Tornambe, "Algebraic Geometry for Robotics and Control Theory", World Scientific Publishing Europe Ltd. 1st Edition, 2021.
2. Joseph Duffy, "Statics and Kinematics with Applications to Robotics", Cambridge University Press, 1st Edition Reprint, 2009.
3. K. S. Fu, Ralph Gonzalez, C.S.G. Lee, "Robotics", , McGraw Hill Publications, Indian Edition, 2017.

Image Source Link:
https://extropynow.weebly.com/uploads/1/6/4/1/16411724/header_images/1358142365.jpg

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22RA902-MOBILE ROBOTICS

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:
This course deals with the fundamental concepts of mobile robots and theoretical aspects of navigation philosophies involved for mobile robots. The objective of this course is to provide knowledge on the concepts of programming requirements for navigation of mobile robots.

MODULE-1

UNIT-1   **9L+6T+0P=15 Hours**
Robot Navigation: Introduction, Navigation Philosophies, Live Reckoning, Navigation as a Filtering process, Sensor Data and Maps, Navigation Software Features, Types of Navigation Sensors and Agents.

UNIT-2   **15L+10T+0P=25 Hours**
Mapping of Robot in a given environment, Navigation of Robot by Collision Avoidance, Path Planning for Navigation, Arbitration and competition among agents

PRACTICES:
- Hands on the hardware of the mobile Robots.
- Analyze and test the path planning algorithm on mobile robot (viz. Two or Three wheeled robot).
- Develop an algorithm for object recognition.
- Familiarize and test the various sensors involved in mobile robot.

MODULE-2

UNIT-1   **9L+6T+0P=15 Hours**
Navigation Programming: Programming vs Teaching Paths, Data embedding in to maps, Map interpreters, events and targets, Text Programming, Hard and Fuzzy Navigation, graphical generation.

UNIT-2   **15L+10T+0P=25 Hours**
Applications and Case Studies relevance to Uncertainty Reduction, Collision Avoidance, Surveillance, Farming, Mine Exploration

PRACTICES:
- Fabrication of the Ariel robots for Spraying Fertilizers.
- Fabrication of the AGV for carrying 30kgs pay load.
- Fabrication of House cleaning robot.
- Uncertainty Reduction in Mapping using C/MATLAB.

COURSE OUTCOMES:

Upon successful completion of this course student will be able to:

No.	Course Outcome	Blooms Level	Module No.	PO
1	Identify the software requirements for mobile robot systems.	Apply	1	1,5,9,10,12
2	Demonstrate navigation of mobile robots.	Analyze	1	1,2,3,5,9,10,12
3	Select appropriate sensor as per guidelines for mobile robots based on end application.	Apply	2	1,2,4,5,9,10,12
4	Develop programs for navigation of Mobile Robots.	Evaluate	2	1,2,5,9,10,11,12

SKILLS:

➢ Recommend software requirements navigation of autonomous robots.
➢ Explain different types of navigation philosophies using mobile robots.
➢ Program mobile robots as per requirement.

TEXT BOOKS:
1. Alonzo Kelly, "Mobile Robotics", Cambridge University Press, 1st Edition, 2013.
2. Roland Siegwart, Illa R Nourbakhsh, Davida Scaramuzza, *Introduction to Autonomous Mobile Robots*, MIT Press, 2nd Edition, 2011.
3. Marco Hutter, Roland Siegwart, "Field and Service Robotics: Results of Springer, 11th International Conference", 2018.

REFERENCE BOOKS:
1. Volkan Sezer, "Service Robotics", Intech Open, 1st Edition, 2020.
2. John M Holland, "Designing Autonomous Mobile Robots", Elsevier, 1st Edition, 2004.

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22RA903-PLANNING AND NAVIGATION

Hours per week

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Programming

COURSE DESCRIPTION AND OBJECTIVES:
This course deals with the planning and navigation concepts required for the field and service robotics working in real time environment. The main objective of this course is to make students familiarize with the algorithms and principles involved while developing navigation algorithms.

MODULE-1

UNIT-1   **9L+6T+0P=15 Hours**
Robot Planning and Navigation: Introduction, Competences for Navigation, Navigation Architectures – Modularity for code reuse and sharing, Control Localization, Decomposition Techniques, Localization and Mapping, Simultaneous Localization and Mapping (SLAM)

UNIT-2   **15L+10T+0P=25 Hours**
Decomposition Techniques - Case Studies, Chicken and Egg problem, Dealing with uncertainty, Exploring Unknown Environments, Goal Navigation, Adaptability to change – Learning and Coping.

PRACTICES:
- Path Integration Calibration.
- Localization and Mapping in 1D.
- Localization and Mapping in 2D.
- SLAM with Artificial Landmarks.
- SLAM in a Loop Environment.
- SLAM in an Office Building.

MODULE-2

UNIT-1   **9L+6T+0P=15 Hours**
Advanced Navigation Programming: Probabilistic Mapping Methods – Kalman Filter Method, Expectization Maximization Method, Particle Filter Method, Topological Mapping Methods, Dealing with Dynamic Environments – Exploration, Goal Navigation, Coping to Change, Biological Navigation Systems, Head Direction and Place Cells – State of the Art, Attractor Networks, Path Integration, Head Direction Correction, Place Cells, Robustness vs Accuracy, Sensory Difference.

UNIT-2   **15L+10T+0P=25 Hours**
Real World Environments Capability, Pilot Study Hippocampal Model. RatSLAM - Model for Spatial Pose, Generation of Local View, Visualization of SLAM – Hippocampal Model, RatSLAM requirements and representation.

PRACTICES:

- SLAM in an Outdoor Environment.
- Small Environment Goal Recall.
- Large Environment Goal Recall.
- Small Pose Cell Representation.
- Large Pose Cell Representation.

COURSE OUTCOMES:

Upon successful completion of this course student will be able to:

No.	Course Outcome	Blooms Level	Module No.	PO
1	Distinguish the localization and Mapping features.	Apply	1	1,5,9,10,12
2	Perform Simultaneous Localization and Mapping	Analyze	1	1,2,3,5,9,10,12
3	Demonstrate SLAM for indoor and outdoor environments.	Apply	2	1,2,4,5,9,10,12
4	Develop algorithms to perform SLAM for dynamic environments.	Evaluate	2	1,2,5,9,10,11,12

SKILLS:

➢ Explain the basics involved in planning and navigation of mobile robots.
➢ Apply SLAM algorithms for localization and mapping of mobile robots in real time environments.
➢ Suggest suitable type of SLAM algorithm for indoor and outdoor environments.

TEXT BOOKS:

1. Alonzo Kelly, "Mobile Robotics", Cambridge University Press, 1st Edition, 2013,
2. Roland Siegwart, Illa R Nourbakhsh, Davida Scaramuzza, *Introduction to Autonomous Mobile Robots,* MIT Press, 2nd Edition, 2011.
3. Marco Hutter, Roland Siegwart, "Field and Service Robotics: Results of Springer, 11th International Conference", 2018.

REFERENCE BOOKS:

1. Volkan Sezer, "Service Robotics", Intech Open, 1st Edition, 2020.
2. John M Holland, "Designing Autonomous Mobile Robots", 1st Edition, Elsevier, 2004.
3. Michael John Milford, Howard, Andrew, "Robot Navigation from Nature", Springer, 1st Edition, 2008.
   Image Source Link:
   http://wiki.ros.org/navigation?action=AttachFile&do=get&target=nav_comic.png

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22RA904-ROBOTIC PROCESS AUTOMATION

Hours per week

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of Robotics and Programming

COURSE DESCRIPTION AND OBJECTIVES:
This course mainly deals with the concepts of process automation using robots. It provides basic knowledge about the required programming skills for robotic process automation.

MODULE-1

UNIT-1   **9L+6T+0P=15 Hours**
Introduction and RPA Skills: Introduction to RPA, History, Benefits, Downsides, Consumer Willingness, Comparison to BPO, BPA and BPM, On-Premise Vs. the Cloud, Web Technology, Programming Languages and Low Code, OCR (Optical Character Recognition), Databases, APIs (Application Programming Interfaces), AI (Artificial Intelligence), Cognitive Automation, Agile, Scrum, Kanban, and Waterfall, DevOps, Flowcharts.

UNIT-2   **15L+10T+0P=25 Hours**
Process Methodologies: Lean, Six Sigma, How to Implement Six Sigma, Six Sigma Roles and Levels, Lean Six Sigma, Finding the Right Balance, Applying Lean and Six Sigma to RPA.

MODULE-2

UNIT-1   **9L+6T+0P=15 Hours**
Vendor Evaluation: Be Realistic, Check Out Third Parties, Minimum Capabilities, Who Is the User? Funding, Ecosystem, Costs, Training and Education, Support, Best-of-Breed vs. End-to-End, Thought Leadership and Vision, Industry Expertise, Security, Monitoring, and Deployment, What Type of RPA? The Design, Next-Generation Technologies

UNIT-2   **15L+10T+0P=25 Hours**
BOT Development: Preliminaries, Installation of UiPath, Getting Started, Activities, Flowcharts and Sequences, Log Message, Variables, Loops and Conditionals, For Each Loop, Do While Loop and While Loop, IF/ THEN/ ELSE Conditionals, Switch, Debug, Common UiPath Functions, The UiPath Orchestrator, Best Practices for Bot Development.

SKILLS:
➢ Illustarte the basic concepts of robotic process automation.
➢ Distinguish the technical aspects and methodologies involved in RPA.
➢ Perform the RPA for Bot Development and Vendor Evaluation.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Demonstrate the concepts and technologies involved in RPA	Apply	1	1, 2
2	Propose the technical aspects and procedure of RPA to achieve Six Sigma in industry	Creating	1	1, 2
3	Evaluate the vendors using RPA	Analyze	2	1, 2
4	Develop the bots for industrial applications.	Developing	2	1, 2

TEXT BOOKS:
1. Tom Taulli, "The Robotic Process Automation Handbook", APress, 1st Edition, 2020.
2. Richard Murdoch, "Robotics Process Automation: Guide to Building Software Robots, Automate Repititive Tasks & became an RPA Consultant", Independently published, 1st Edition, 2018.

REFERENCE BOOKS:
1. Mary C. Lacity and Leslie P. Willcocks, "Robotic Process and Cognitive Automation", ISBN: 978-0995682016, 2018.

Image Source Link: https://www.claysys.com/app/uploads/2019/07/Robotic-Process-Automation-Use-Cases.png

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22RA905-ROS PROGRAMMING

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of Robotics, Programming

COURSE DESCRIPTION AND OBJECTIVES:
This course offers the basic concepts of robot programming the robots using C++, Python and ROS. The objective of the course is to make the students comfortable on programming the robots with different platforms.

MODULE-1

UNIT-1   **9L+6T+0P=15 Hours**
Robot Programming: Robot Programming and its importance, genesis of robot programming. UBUNTU - Fundamental Concepts, Installation, PC requirements, Installation of Virtual Box, GUI, Terminal commands, cheat sheet.

UNIT-2   **15L+10T+0P=25 Hours**
C/C++ in Ubuntu, Introduction GCC and G++ compilers, OOP concepts, Case Studies Introduction to Python, Installation of Python in Ubuntu, Basic Python Commands, Case Studies.

PRACTICES:
* Hands on session Arduino interfacing.
* Hands on session on Raspberry interfacing.
* Interfacing ROS and Arduino.
* Interfacing ROS and Raspberry.
* Programming Mobile robot navigation using Python.
* Programming Mobile robot navigation using C++.

MODULE-2
UNIT-1   **9L+6T+0P=15 Hours**
ROS Programming: Getting started with ROS, ROS equation, History of ROS, before and after ROS, use of ROS, Installation of ROS**,** Robots and Sensors supporting ROS, ROS platforms, ROS Architecture and Platforms, ROS file system, ROS Command Tools.

UNIT-2   **15L+10T+0P=25 Hours**
ROS Programming – Navigation, Hardware Configuration, Sensor Interfacing, Image Capturing.
PRACTICES:
* Interfacing ROS and Arduino.
* Interfacing ROS and Raspberry.
* Programming Mobile sensor interfacing using ROS.
* Programming Mobile image capturing using ROS.
* Programming Mobile robot navigation using ROS.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to:

No.	Course Outcome	Blooms Level	Module No.	PO
1	Distinguish the platforms for Robot programming.	Apply	1	1,5,9,10,12
2	Apply basic coding skills in programming the robot.	Apply	1	1,2,3,5,9,10,12
3	Demonstrate the ROS programming codes based on end application.	Analyze	2	1,2,4,5,9,10,12
4	Develop ROS programming for simple applications.	Evaluate	2	1,5,9,10,11,12

SKILLS:

➢ Install Ubuntu, C++, python and ROS.
➢ Perform coding for robot programming using C++, Python and ROS
➢ Interface ROS with Arduino and Raspberry.

TEXT BOOKS:

1. Lentin Joseph, "Robot Operating System for Absolute Beginners", APRESS, 1st Edition, 2018.
2. Morgan Quigley, Brian Jerkey, William D. Smart, "Programming Robots with ROS: A Practical Introduction to the Robot Operating System", O'Reilly Media, 1st Edition, 2016.
3. Enrique Fernandez, Luis Sanchez Crespo, Anil Mahtani, Aaron Martinez, "Effective Robotics Programming for ROS", Packt Publishing, 3rd Edition, 2016.

REFERENCE BOOKS:

1. Anis Koubaa, "Robot Operating System (ROS): The Complete Reference", Springer, Volume II, 2017.
2. Wyat S. Newman, "A Systematic Approach to Learning Robot Programming with ROS", Chapman and Hall/CRC, 1st Edition, 2017.
3. Enrique Fernandez, Luis Sanchez Crespo, Anil Mahtani, Aaron Martinez, "Learning ROS for Robotics Programming", Packt Publishing, 2nd Edition, 2015.

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MINOR ON HUMANITIES AND SOCIAL SCIENCES
Offered by Department of Training and Placements

       Minor in Humanities and Social Sciences benefits students of science and technology as they are introduced to the disciplines of humanities and social sciences. Courses offered, such as "Introduction to Creative Writing", as a part of this minor will enhance writing skills of students as well as their ability to articulate themselves, not only on issues pertaining to society but also in their core areas of specialisation. Students, through the rest of the courses - such as "Introduction to Sociology", "Introduction to Political Economy", History of Political Thought", and "Relevance of Gandhian Thought to 21st Century", - will also be exposed to a knowledge-base that broadens their world-view and provides an added dimension to their understanding of our changing social world. These minor courses serve as a window into the academic milieu of Humanities and Social Sciences.

Course Code	Course Title	L	T	P	C
22TP903	History of Political Thought	3	2	0	4
22TP905	Introduction to Creative Writing	3	2	0	4
22TP907	Introduction to Political Economy	3	2	0	4
22TP908	Introduction to Sociology	3	2	0	4
22TP910	Relevance of Gandhian Thought to 21st Century	3	2	0	4

Hours per week:

PREREQUISITE KNOWLEDGE: High school level civics and social studies.

L	T	P	C
3	2	0	4

COURSE DESCRIPTION AND OBJECTIVES:

The paper introduces the student to the contemporary socio-economic and Political Traditions of the West and India. It brings the major component of the state and its application in Political Science through the Philosophical discourse of the western and Indian political thinkers. The paper focuses on the concept of state and its evaluation and refinement in the contemporary social condition. It also discusses contemporary society and its application towards the construction of the model of state, and also will certainly enrich our students to feel confident about the traditional values of Indian Nationalism that evolved over a course of time. India carries a long tradition of political thought which is quite distinct from western political thought. The paper aims to make the student familiar with the great tradition of Indian political thought. special care has been taken to make students aware of the concepts developed by the leading political thinker of India.

In the current intellectual climate that embraces an interdisciplinary approach, this course brings together diverse fields from the discipline of Political Science - such as Political Thought, Political Theory, Indian Thought and Philosophy of the Social Sciences.

MODULE-1

UNIT-1 12L+8T+0P=20 Hours
WESTERN CLASSICAL THINKERS
Plato, Aristotle, Niccolò Machiavelli, Thomas Hobbes, John Locke, Jean-Jacques Rousseau.

UNIT-2 12L+8T+0P=20 Hours
MEDIEVAL THINKERS
Jeremy Bentham, John Stuart Mill, Hegel, Karl Marx, Antonio Francesco Gramsci and Mao Zedong, John Rawls.

PRACTICES:

- Frame a broad outlook to the philosophical dimensions of Political Thinkers- the concept of state and its evaluation & refinement in the contemporary social Condition.
- Discusses the contemporary society and its application towards the construction of the model of state- Italian Renaissance period- The Contractualist political thinkers.
- The contemporary society and its application towards the construction of the model of Indian state.
- Analyse the trends in distributive Justice in the society.
- Get a glimpse of the contemporary human nature.
- the evolution of the contemporary western socio-economic political tradition.

MODULE-2
UNIT-1   **12L+8T+0P=20 Hours**
NATURE AND THEMES OF INDIAN POLITICAL THOUGHT
Kautilya, Vivekananda, Tagore and Sri Aurobindo, Gandhiji, Pandita Ramabai & Savitribai Phule.

UNIT-2   **12L+8T+0P=20 Hours**
THEMES OF INDIAN POLITICAL THOUGHT
Jawaharlal Nehru, Dr. B.R. Ambedkar, Periyar, M.N Roy, Ram Manohar Lohia, J.P. Narayan, M.S. Golwankar ,V.D. Savarkar, Deendayal Upadhyaya.

PRACTICES:
- The important philosophical themes of Indian Political thinkers relevant to India.

SKILLS:
➢ Understand the basic tenets of Political Thought of Western and Indian Thinkers.
➢ Understand the philosophy so as to have better understanding about state and Society.
➢ Critically be able to analyse the concepts like State, Society, Justice, Equality, Rights, Government.
➢ Understand the socialistic and Hindutva thought and its impact on India.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with PO's
1	Analyse the philosophical dimension of Greek thinkers to understand the evolution of the state.	Apply	1	6
2	Gain knowledge of Indian Tradition, value system, and Indian thought from the classical thinkers of India.	Analyse	2	6
3	Analyse the Socialistic and Hindutva Thoughts of thinkers of India.	Analyse	2	6
4	Evaluate the modern structure of the society and state through the philosophical teachings of medieval thinkers.	Evaluate	1	6

TEXTBOOKS:
1. Shefali Jha, "Western Political Thought", Pearson Publication, New Delhi, 2008.
2. O. P. Gauba, "Political Theory", Mayur Paperback, New Delhi, 2009.

REFERENCE BOOKS:
1. Rajeev Bhargava, "Political Theory", Pearson Publication, New Delhi, 2008.
2. O. P. Gauba, "Indian Political Thought", Mayur Paperback, New Delhi, 2016.
3. Himanshu Roy, "Indian Political Thought", Pearson Publication, New Delhi, 2020.
4. J.W. Allen, "A History of Political Thought in the Sixteenth Century", Borodino Books, 2018.
   Karl Poper, "Open Society and Its Enemies", Princeton University Press, 2013.

5. John Plamentaz, "Man and Society", 2nd Edition, Longman, 1992.

Image:　　　　　https://www.theguardian.com/commentisfree/belief/2009/sep/21/plato-dialogues-philosophy
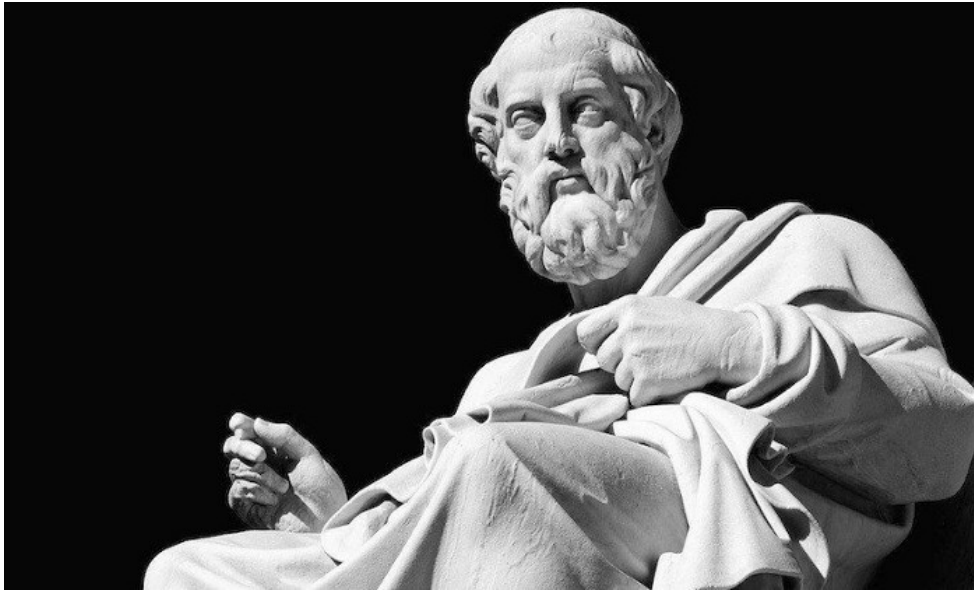
22TP905-AN INTRODUCTION TO CREATIVE WRITING

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Technical English Communication.

COURSE DESCRIPTION AND OBJECTIVES:
This course aims to introduce engineering students to the world of creative writing. Students, in this course are exposed to a wide variety of writing styles to inculcate an appreciation for various writing styles. With the knowledge-base from this course, students can respond to social issues and publish their ideas and opinions in the newspapers and magazines besides articulating their own personal experiences. Moreover, the course focuses on improving the students' vocabulary levels and lucid style in a plethora of paragraphs and essays on various platforms. After successfully completing this course, students will be able to - write error free narratives of personal experiences, travelogues and blogs; write argumentative and persuasive essays with lucidity and clarity within the frame, write newspaper articles to sustain the reader's interest, develop wide spectrum of vocabulary in addition to own style of writing and, discriminate the formal and informal style of writing by following gender sensitivity, neutral variety of English and ethics of journalism.

MODULE-1
UNIT-1   **12L+8T+0P=20 Hours**
WRITING AND STYLE
Writing and its importance; The substance of writing: Content, Form, Structure, Paragraphing; Style: Elements of lucidity and clarity in writing.

UNIT-2   **12L+8T+0P=20 Hours**
WRITING OF PERSONAL EXPERIENCES
Narrating a personal experience - A travelogue/memoir, Blog format, for the audience on the Internet.

PRACTICES:
- Familiarizing idioms, Phrases; Synonyms and antonyms; figures of speech.
- Style register - formal, informal usage; varieties of English; language and gender; disordered languages.
- Playing with words; grammar and word order; tense and time.
- Grammatical differences.
- Writing a personal experience - writing about a place visited, writing a blog on a personal experience.

MODULE-2

UNIT-1   **12L+8T+0P=20 Hours**
WRITING FOR MEDIA
A sampling of reports, articles for a paper, editorials; Audience analysis, Building interest, Persuasive/argumentative style – counter arguments, rebuttals; effective ending.

UNIT-2   **12L+8T+0P=20 Hours**
ASSESSING SOURCES FOR WRITING
Studying and analysing good samples/sources of writing from newspaper and magazines.

PRACTICES:
- Making notes.
- Writing outlines.
- Rough drafts.
- Appreciating a short story.
- Book review.
- Writing an article for a paper (writing in a persuasive/argumentative style, using analogies, sustaining reader's interest).

SKILLS:
- Using different styles in writing.
- Incorporating functionality and flair in writing.
- Writing geared towards a specific audience.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with PO's
1	Write various layouts of paragraphs and essays.	Apply	1 & 2	9,10,12
2	Analyse, apply and formulate one's own style of writing.	Analyze	1 & 2	2, 9,10,12
3	Formulate various techniques based on the situations to sustain the readers' interest on various platforms.	Analyze	1 & 2	2,8,9,10,12
4	Evaluate various conditions and situations of the society and justify their ideas and opinions by using suitable vocabulary in their writings.	Evaluate	1 & 2	2,8,9,10,12
5	Develop courage to face various examinations conducted by both state and central governments.	Create	1 & 2	2,9,10,12

TEXTBOOKS:
1. V. R. Narayanaswami, "Strengthen Your Writing", 3rd Edition, Orient Longman, 2005.
2. Lurie G. Kirszner and Stephen R. Mandell, "Patterns for College Writing: A Rhetorical Reader and Guide", 15th Edition, Macmillan Learning, 2021.

REFERENCES:

1. Christopher Vogler, "The Writer's Journey: Muthic Structure for Writers", 4th Edition, Michael Wiese Productions, 2020.
2. Roy Peter Clark, "Writing Tools: 55 Essential Strategies for Every Writer", Little Brown and Company, 2006.

Image: https://essayscouncil.net/creative-writing/
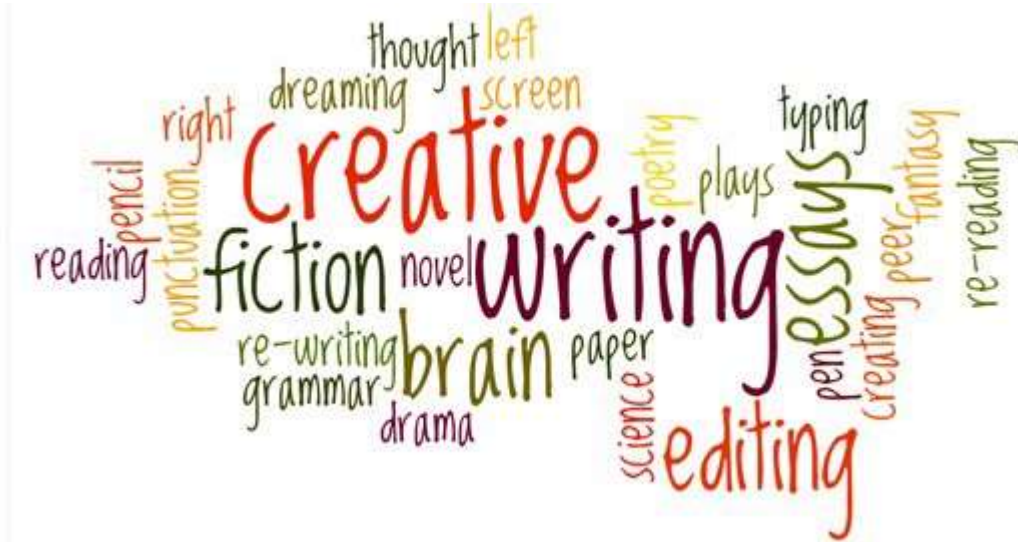
Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: High school level social studies.

COURSE DESCRIPTION AND OBJECTIVES:
This course introduces the basic understanding of Political Economy. This paper is intended to give a broad outlook on the dimensions of the Political Economy of the West and India besides equipping them with the tools to analyse the state of current scenarios globally.

MODULE-1

UNIT-1   **12L+8T+0P=20 Hours**
INTRODUCTION TO POLITICAL ECONOMY:
Meaning, History and Development, Characteristics, Modern Applications.

UNIT-2   **12L+8T+0P=20 Hours**
TYPES AND APPROACHES OF POLITICAL ECONOMY:
Socialism, Laissez-Faire, Communism, Mercantilism, Liberalism. Approaches to Political Economy **-** Ricardian approach, Marxian Approach, Malthusian Approach, Keynesian Approach.

PRACTICES:
- Seminar on comparing and contrasting different types of political economy.
- A detailed project report on type of political economy present in India.

MODULE-2

UNIT-1   **12L+8T+0P=20 Hours**
WELFARE:
Cardinal Utility, Ordinal Utility, Pareto Efficiency, Growth Inequality, Social welfare maximisation.

UNIT-2   **12L+8T+0P=20 Hours**
INTERNATIONAL POLITICAL ECONOMY:
Globalisation; International Trade; International Organisations - UN, NATO; International Economic Institutions -WTO, IMF, WB; International Political Scenarios - America, Russia, Europe, China.

PRACTICES:
- Field work on various welfare schemes and the outcomes.
- Look into three other international economies of your choice and make a presentation with respect to contemporary situations.

SKILLS:
- ➢ Understand the basics of Political Economy and evolution global political economy.
- ➢ Understand the challenges in the Political Economy globally.
- ➢ Examine various ideas of different economic thinkers of the time period.
- ➢ Able to understand the shifts in Indian Economy and transformation in the globally connected economic society.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with PO's
1	Analyse the evolution of global Political Economy.	Analyse	1	6
2	Gain the knowledge of economic systems from various thinkers.	Analyse	2	6
3	Evaluate the contemporary scenarios of various state economies.	Evaluate	1	6
4	Examine the shifts in the Indian political economy.	Evaluate	2	6

TEXTBOOKS:
1. Vincent Bladen, "An Introduction to Political Economy", Creative Media Partners, 2021.
2. Ira Katznelson and Helen V. Milner, "Political Science: The State of the Discipline." W.W. Norton, 2004.

REFERENCE BOOKS:
1. John Stuart Mill, "Principles of Political Economy: With Some of their Applications to Social Philosophy", Oxford University Press, 1998.
2. Alfred Marshall, "Principles of Economics", Cosimo Classics, 2006.
3. Jeffry Frieden and Lisa Martin, "International Political Economy: Global and Domestic Interactions", W. W. Norton, 2003.
4. Benjamin J. Cohen, "International Political Economy: An Intellectual History", Princeton University Press, 2008.

Image: https://www.balsillieschool.ca/event/what-is-the-purpose-of-international-political-economy/

Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basic understanding of society.

COURSE DESCRIPTION AND OBJECTIVES:
This course is designed as an introduction to the field of sociology. The purpose of this course is to provide an academic background in the sociological paradigms, which are presented to students in broadly two modules. Module I - examines the origins of the discipline of sociology and its significance to our understanding of everyday life by putting forth the basic concepts about our social reality. It also introduces students to sociological perspectives and research methods that are foundational for the discipline. Module II - introduces students to various aspects of inequality from a sociological perspective. It also sets out to evaluate social inequality in terms of caste, social class, gender, and even global inequalities.

MODULE-1
UNIT-1   **12L+8T+0P=20 Hours**
INTRODUCTION TO SOCIOLOGY; THREE REVOLUTIONS; AND BASIC CONCEPTS:
Defining sociology - meaning, scope and its significance; Sociological Imagination; Origins of the discipline of Sociology - Scientific Revolution, Industrial Revolution, and French Revolution; Basic Concepts - individual and society, nature vs. nurture, culture - values and norms, cultural diversity, ethnocentrism, socialization and agents of socialization.

UNIT-2   **12L+8T+0P=20 Hours**
SOCIOLOGICAL PERSPECTIVES & METHODS:
Sociological Perspectives - Functionalist Perspective, Conflict Perspective, and Symbolic Interactionist Perspective; Research Methods - surveys, experiments, comparative research, historical analysis, ethnography, human subjects and ethical problems in research.

PRACTICES:
- Analysing case studies that highlights various sociological concepts. For instance, while talking about nature v. nurture - controversial case studies of feral girls (wolf children) of Bengal and Genie the Wild Child.
- Practicing research methods such as preparation of questionnaires, conducting of surveys, and participant observation.

MODULE-2
UNIT-1   **12L+8T+0P=20 Hours**
SOCIAL INEQUALITY AND SOCIAL CHANGE
Social Stratification and Change: Marxist, Weberian and functionalist perspectives on stratification; caste system; *jajmani* system; sankritisation; westernisation, secularisation and modernisation; Intersectionality - Class, sex, gender, caste.

UNIT-2   **12L+8T+0P=20 Hours**
GLOBALIZATION
Globalization and the Changing World: Determinants and Effects of globalization; nation-state, nationality and globalization; globalization and culture; globalization and inequality.

PRACTICES:
- Browsing the internet as a resource for understanding global culture. Example: exploring McDonalds and PizzaHut and other restaurants to understand cultural hegemony.
- Collecting news published in the local papers about cultural traditions and social issues in our society.

SKILLS:
➢ Basic understanding of the discipline of sociology.
➢ Understand the dynamic between the individual and society.
➢ Critically think about societal issues both globally and locally.
➢ Ability to carry on meaningful and educated conversations about sociology and deploy sociological understanding to explain various issues.
➢ Ability to clearly articulate ideas in writing as well as orally on various societal issues.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to:

CO No.	CO's	Blooms Level	Module No.	Mapping with PO's
1	Analyse society through the prism of sociology as an academic discipline.	Analyse	1	6
2	Demonstrating the interplay between the individual and society, i.e., how society shapes the development of individuals and how individuals shape society.	Analyse	2	6
3	Analysing human behavior as manifested in various social institutions and societal culture.	Analyse	2	6
4	Evaluate basic theoretical perspectives and methodological orientations in sociology.	Evaluate	1	6
5	Critically evaluating social inequality in its multiple forms and social change.	Evaluate	2	6

TEXTBOOKS:
 1. M. Haralambos and M. Holborn, "Sociology: Themes and Perspectives", 8th Edition, Harper Collins, 2014.
 2. Dipankar Gupta, "Social Stratification", Oxford University Press, New Delhi, 2010.

REFERENCE BOOKS:
 1. Anthony Giddens, "Sociology", 5th Edition, Polity Press, 2006.

2. M. N. Srinivas, "Social Change in Modern India", Orient Blackswan, New Delhi, 2007.

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Hours per week:

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: High school-level history of India and the freedom struggle.

COURSE DESCRIPTION AND OBJECTIVES:
This course is designed as an introduction to Gandhian Thought. The purpose of this course is to provide an academic background in the Gandhian paradigms, which is presented to students in broadly two modules. Module I - examines the historical background of the origins of Gandhian Thought, its influences, and fundamental tenets. Module II - introduces students to his thoughts on social transformation, economic thought, and the impact of Gandhi on modern world politics.

MODULE-1
UNIT-1   **12L+8T+0P=20 Hours**
INTRODUCTION TO GANDHIAN THOUGHT:
The early 20th-century political scenario in India and World (with special reference to Great Britain and South Africa); Non – Violent techniques (Conflict Resolution, Social Justice and Reform, Self-Rule, Nation Building).

UNIT-2   **12L+8T+0P=20 Hours**
INFLUENCES ON GANDHIJI'S THOUGHT:
Influence of the Oriental Culture; Impact of the Western thought; Influence of different religions; Fundamental Concepts in Gandhian Thought; Sadhya-sadhan Shuchita; Ahimsa; Satya.

PRACTICES:
- Examine the historical background of Mahatma Gandhi's thought.
- Find the relevance of Gandhian way of life in the society.
- Ascertain the difference between western political thought and Gandhian thought.
- The impact of Gandhi on Indian Culture.

MODULE-2
UNIT-1   **12L+8T+0P=20 Hours**
GANDHIJI'S THOUGHTS ON SOCIAL TRANSFORMATION:
Religious Harmony; Removal of Untouchability; Women's Emancipation; Economic Thought of Gandhiji; Value-Based Approach; Critique of Modern Civilization; Swadeshi and Khadi; Self-sufficient Village System.

UNIT-2   **12L+8T+0P=20 Hours**
IMPACT OF GANDHIAN THOUGHT
Impact of Gandhian Thought on the Constitution of India; Vinoba Bhave and Bhoodan Movement; Martin Luther King and Movement against Racism.

PRACTICES:
- The impact of Gandhi on Indian religions.
- Analyse the economic thought of Gandhi and its relevance to the present.
- Evaluating the importance of Vinoba Bhave and the Bhoodan Movement.
- The impact of Gandhi on Indian Culture.

SKILLS:
- Analyse the importance of Gandhian Thought in Contemporary society.
- Compare different perspectives of Western Political Thought and Gandhian Thought.
- Identify the impact of Gandhiji on Indian Culture, Religion, Social Transformation, Indian Constitution.

COURSE OUTCOMES:
Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with PO's
1	Analyse the historical background of Gandhi.	Analyze	1	6
3	Gain the knowledge of Indian Tradition, Social Transformation, and economic thought of Gandhi.	Analyse	2	6
2	Examine the difference between western political Thought and Indian Political Thought.	Evaluate	1	6
4	Evaluate the impact of Gandhi on Indian culture, religion, making of the Indian Constitution, and movements.	Evaluate	2	6

TEXTBOOKS:
1. Ram Chandra Guha, "Gandhi: The Years That Changed the World, 1914-1948", Penguin Allen Lane, 2018.
2. Ram Chandra Guha "India After Gandhi: The History of the World's Largest Democra**cy"**, Picador India, 2017.

REFERENCE BOOKS:
1. The collected works of Mahatma Gandhi (All volumes).
2. M.K Gandhi. "My Experiments with Truth (Autobiography)".

Image: https://sambadenglish.com/odisha-guest-house-that-hosted-mahatma-gandhi-to-become-museum/
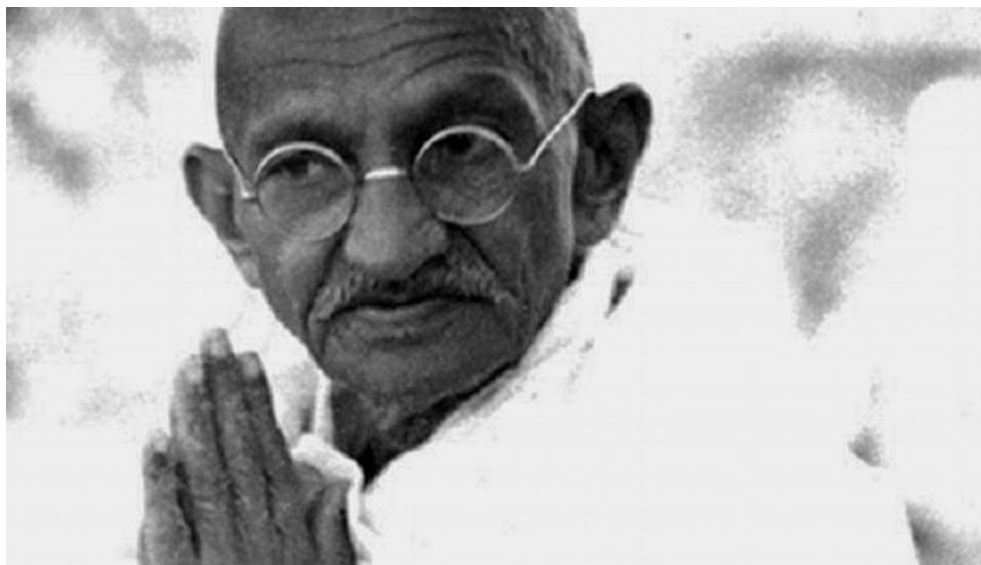
MINOR ON WAYS OF WELLBEING

Offered by Student Affairs and Physical Education

Wellbeing is fundamental to our health and overall happiness. Having a strong and well-adapted sense of wellbeing can help overcome difficulties and help achieve the goals in life. Research has shown that a greater sense of wellbeing relates to increased physical benefits, such as lower incidences of cardiovascular disease, stroke and sleeping problems, and with increased productivity and creativeness in both employment and personal lives. In short, having high levels of wellbeing helps us to be the best versions of ourselves.

Enhancing the wellbeing isn't always easy, but it is always worth it. Eating a healthy balanced diet, getting enough sleep and exercise, and creating healthy habits to look after your physical health are some of the easiest ways to help develop your sense of wellbeing (although, this is often easier said than done).

Partaking in an activity that fully captures our engagement helps us to be "in the moment" and enables time to "fly by". These types of activities flood our brains with happy hormones and neurotransmitters and help to enhance our intelligence, skill and emotional capabilities.

Isolation can be detrimental to us physically and emotionally. Positive relationships with other people can bring us great joy, a sense of safety and value, and can provide support when times get difficult.

This minor is being introduced to let the students know the importance of wellbeing and how it affects the happiness levels of a person. In this minor several aspects are covered such as physical, psychological, emotional and relational wellbeing.

The different subjects offered under ways of wellbeing are:

Course Code	Course Title	L	T	P	C
22SA901	Physical wellbeing	2	0	4	4
22SA902	Psychological wellbeing	2	0	4	4
22SA903	Emotional wellbeing	2	0	4	4
22SA904	Relational wellbeing	2	0	4	4
22SA905	Case study - Project	2	0	4	4

Hours per week			
L	**T**	**P**	**C**
2	-	4	4

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:
This course provides an insight about human body as its functioning is influenced by physical activities and provides the necessary knowledge of the theory and practice of yoga to practice yoga for promoting their health and effectiveness.

MODULE 1

UNIT-1   6L+0T+12P= 18 Hours
INTRODUCTION TO YOGA AND HUMAN BODY:
Definitions and development of 'Yoga'-Aim, objectives and scope of yoga, Traditional literature on yoga- Rules and Regulations for Practice of Yoga.
Introduction to human body: Skelton -Cell and Tissues - Bones & muscles, The Circulatory System, The Respiratory System, Introduction to Endocrine glands, The Nervous System.

UNIT-2   10L+0T+20P=30   Hours
INTRODUCTION TO POSTURES:
Meditative Postures: Sukhasan, Swastikasana; Vajrsan; Ardha padmasan, padmasan, Siddhasan;
Relaxation postures: Shavasana; Advasana; Jyeshtikasana; Makharasana; Matsya kridasana

MODULE 2
UNIT-1   6L+0T+12P= 18 Hours
SCHOOLS OF YOGA AND YOGA DARSHAN:
Branches of Yoga: Bhakti Yoga- Karma Yoga- Jnana Yoga- Mantra Yoga-Kundalini Yoga
Techniques of hatha yoga: Shat kriya, Asanas, Pranayams, Bandhas and Mudras.
Structure of yoga sutras, Chitta vritties, Abhyasa & Vairagya, Concept of Ishwara, Yoga obstacles, Pancha Kleashas, Astanga Yoga

UNIT-2   10L+0T+20P=30 Hours
INTRODUCTION TO KRIYAS:
Kriyas: Jalaneti, Sutraneti, Jala Dhauti, Vastra Dhauti, Varisara Dhauti (Sankhaprakshalana).
Standing postures: Tiryak Tadasana, Trikonasana, Parivrita Trikonasana, Katichakrasana; Parsvakonasan.
Balancing Postures: Tadasana; Vrikshasana; Natarajasan; Ekapadasana; Merudandasana.
Sitting postures: Bhadrasana; Virasana; Supta Veerasan; Vakrasana; Ardha –matsyendrasana

SKILLS:
- Ability to self regulate.
- Ability to recover quickly from difficulties.
- Ability to do team work.
- Ability to express confidently.
- Ability to think creatively.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand the knowledge about the theory and practice of Yoga and its nature.	Analyze	1,2	1,2,6,9
2	Make familiar with the different system of the body with Yogic approach.	Apply	1,2	1,2,9,12
3	Skills in explanation and demonstration of various Yogic practices.	Apply	2	1,2,3,9,12
4	Understood the information about the importance of diet and nutrition.	Evaluate	2	1,2,9,12
5	Ability to set up Yoga therapy center and skill to maintain case studies.	Create	1	1,2,3,9,12

TEXT BOOKS:
1. Sachitra Yoga pradipika: B. K. S. Ayyanger
2. Yoga Chaitanya Pradipika: Yogacharya Dr. Raparthi Ramarao

REFERENCE BOOKS:
1. Journey to Real Self: Dr. Raparthi Ramarao
2. Asana pranayama Mudras Bandhas: Swami Satyananda Saraswati

Image source
https://www.entrepreneur.com/en-in/lifestyle/importance-of-physical-wellbeing-during-this-lockdown/353697

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Physical wellbeing

22SA902-PSYCHOLOGICAL WELLBEING

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:

This course is to understand the well-being paradigm and develop a perspective in order to understand the increasing vulnerability in a changing context. This course enables the learner to explore the concept of mental health and to distinguish the same from mental illness and appreciate the significance of mental health promotion.

MODULE-1

UNIT-1   **6L+0T+12P=18 Hours**
INTRODUCTION
Key components of psychological wellbeing, Types of psychological wellbeing.

UNIT-2   **10L+0T+20P=30 Hours**
KEY ISSUES AND CONCERNS OF ADOLESCENTS
Defining Adolescence, Challenges during adolescence, Depression, Bullying, Substance Abuse, Cyber Issues, Obsessive Compulsive Behaviours, Abuse and Trauma

MODULE-2

UNIT-1   **6L+0T+12P=18 Hours**
NEUROCHEMICAL EFFECTS
Patterns of Brain Activation, Neurochemical Effects.

UNIT-2   **10L+0T+20P=30 Hours**
SOCIAL FACTORS
Social Factors and Brain Development, Genetic Factors, Personality, Self-esteem, Self-confidence, Resilience

SKILLS:
- Personal growth and development.
- Self-acceptance
- Pay attention to the present moment (mindfulness)
- The pursuit of meaningful goals and a sense of purpose in life.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand the fundamentals concepts of Psychological wellbeing.	Create	1	1,2,6,9
2	Predict outcomes of social situations by applying principles social factors.	Analyze	1,2	1,2,9,12
3	Apply the knowledge of psychological wellbeing in different walks of life	Apply	1,2	1,2,3,9,12
4	Empower to measure Interest, Intelligence, Aptitude, Personality, Adjustment skills etc.	Evaluate	2	1,2,9,12
5	Conceptualize adolescents behaviour & personality in holistic way.	Create	1,2	1,2,3,9,12

TEXT BOOKS:
1. Principles of Psychology by William James.
2. Stumbling on Happiness by Daniel Gilbert.

REFERENCE BOOKS:
1. Snyder, C. R., Shane J. Lopez, and Jennifer Teramoto Pedrotti. Positive Psychology: The Scientific and Practical Explorations of Human Strengths. 2nd ed.
2. Why Zebras Don't Get Ulcers, by Robert M. Sapolsky.
3. Wellness: Mental Health - Robert E. Kime - Hardcover

Image source:
http://www.howard-fensterman-charities.com/2017/12/importance-mental-health-counseling/

Image filename:
Psychological wellbeing

22SA903-EMOTIONAL WELLBEING

Hours per week			
L	**T**	**P**	**C**
2	-	4	4

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:

The course deals with emotional attributes of humans. Also, elaborates on applications of emotions at workplace and developing prosocial behaviour.

MODULE-1

EMOTIONAL WELLBEING

UNIT-1   **6L+0T+12P =18 Hours**

Introduction: Emotional Intelligence; Models of Emotional Intelligence; EQ Competencies: Self Awareness, Self-Management, Empathy, and Interpersonal Skills; Importance of Emotional Intelligence.

Knowing one's own and other's emotions: Levels of emotional awareness; Recognizing emotions in oneself; The universality of emotional expression; Perceiving emotions accurately in others.

UNIT-2   **10L+0T+20P=30 Hours**

PRO SOCIAL BEHAVIOUR

Developing Prosocial behaviour: Promoting positive emotions, Empathy-Altruism Hypothesis, Negative-State Relief Hypothesis, Empathetic Joy Hypothesis

Five Decision Points in Pro-social Behaviour: Notices something unusual in the situation, interprets it as an emergency, Assumes responsibility to help, Understanding if you have the skill required to give help and decide how to help, Decide to implement help.

MODULE-2

UNIT 1   **6L+0T+12P=18 Hours**

STRESS AND COPING

Introduction: Types of stress, Sources of stress, Stress Response.

Coping Mechanisms: Coping Mechanisms: Appraisal focused, Emotional focused and Problem focused.

Stress Reduction Techniques: 1. Autogenic Training 2. Biofeedback 3. Relaxation 4. Yoga and Meditation

UNIT 2   **10L+0T+20P=30 Hours**

MANAGING EMOTIONS

Managing Emotions: The relationship between emotions, thought and behaviour; Techniques to manage emotions.

Applications of Emotional Intelligence: Workplace; Relationships; Academics.

SKILLS:
- Design models for interpersonal relations
- Develop techniques to manage emotions.

- Perceive emotions in others.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Enable to understand how positive emotional states contribute to resilience, happiness, and wellbeing.	Analyze	1,2	1,2,6,9
2	To foster the ability to identify and manage one's own emotions, as well as the emotions of others.	Apply	1,2	1,2,9,12
3	Help to deal with negative emotional states and promote more positive emotions in its place	Apply	2	1,2,3,9,12
4	To appreciate the application of emotional intelligence in myriad settings, such as the workplace, relationships, etc.	Evaluate	2	1,2,9,12
5	Identify and implement the stress relaxation techniques in daily life.	Apply	2	1,2,9,12

TEXT BOOKS:
1. Emotional Success: The Power of Gratitude, Compassion and Pride. by David DeSteno.
2. The Book of Human Emotions: An Encyclopedia of Feeling from Anger to Wanderlust. by Tiffany Watt Smith.

REFERENCE BOOKS:
1. Anand, P. (2017). Emotional Intelligence: Journey to Self Positive. New Delhi: The Readers Paradise.
2. Bar-On, R., & Parker, J.D.A. (Eds.) (2000). The Handbook of Emotional Intelligence. San Francisco, California: Jossey Bros.
3. Goleman, D. (1995). Emotional Intelligence. New York: Bantam Book.

Image source:
https://www.rutgers.edu/news/maintaining-emotional-health-and-wellbeing-during-covid-19

Image filename
Emotional wellbeing

22SA904-RELATIONAL WELLBEING

	Hours per week		
L	**T**	**P**	**C**
2	0	4	4

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an insight about the Relationships to develop an understanding of the concept of individual differences with the goal to promote self-reflection and understanding of self and others.

MODULE-1

UNIT 1   **6L+0T+12P= 18 Hours**
RELATIONAL WELLBEING
Introduction: Healthy Versus Unhealthy Relationships, Building Social Bonds - Connections That Promote Well-Being, Ways to Improve Relational Wellbeing
The Dimensions of Relational wellbeing: Subjective, Relational, Material

UNIT 2   **10L+0T+20P = 30 Hours**
Introduction: Meaning and benefits of Interpersonal skills, Components of Interpersonal skills, Techniques of improving Interpersonal skills.

MODULE-2

UNIT 1   **6L+0T+12P= 18 Hours**
GERONTOLOGY
Introduction: Physical and social Aspects of Aging, Nutrition and Exercise, Disorders and Disabilities of old people, Principles of Gerontological Nursing, Approach to an elderly patient, Tools & scales for assessment, Assessment of Psychosocial and physical environment of elderly, Dietary assessment, life style, Anthropometry of old people, Counselling the older person, Common problems requiring counselling.

UNIT 2   **10L+0T+20P= 30 Hours**
RELATIONAL WELLBEING WITH PEERS
Marital, couple, and family life cycle dynamics, healthy family functioning, family structures, and development in a multicultural society, family of origin and intergenerational influences, cultural heritage, socioeconomic status and belief systems, Societal trends and treatment issues related to working with diverse family systems (e.g. Families in transition, dual-career couples, and blended families)
Applications of Healthy Relationships: Family, Workplace, School/College, Peer group.

SKILLS:
- Ability to communicate effectively
- Ability to understanding of self and others.

- seeking and offering help when needed.
- Building healthy relations with family, friends, elders and old people.
- Active listening.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand the basic relationship of Individual with society.	Create	1,2	1,2,6,9
2	Understand the importance of interpersonal relations, love and aggression in social world.	Create	1,2	1,2,9,12
3	Work on Decision making process, Team building and group dynamics in outer world.	Analyze	1,2	1,2,3,9,12
4	Apply the concepts of promoting healthy relationships for the community	Apply	1,2	1,2,9,12
5	Critically evaluate symptoms, and treatments of various types of disabilities of old people.	Evaluate	2	1,2,9,12

TEXT BOOKS:
1. Wellness: Mental Health - Robert E. Kime – Hardcover
2. Contemporary Perspectives on Relational Wellness - Psychoanalysis and the Modern Family

REFERENCE BOOKS:
1. Creating relationship wellness by Stephanie Wijkstrom
2. Mindful Relationship Habits by S.J. Scott and Barrie Davenport

Image source
https://www.commonwisecare.com/advantages-of-taking-care-of-the-elderly-at-home/

Image filename
Relational wellbeing

MINOR ON PHOTOGRAPHY AND DIGITAL FILM MAKING
Offered by Student Affairs and Physical Education

Photography has been simplified in recent years, with various innovations in mobile technology and photo editing software making it easier for amateur photographers to take and design images of professional quality or at least close to it. This all sounds well and good, but there is also some risk that it is undermining the true importance of photography, and the positive effect it can have on our families.

Consider making an effort to have professional photos done the right way for important events and experiences, and take steps to collect and preserve older photographs. The value of photography is clear that we can relook into our memories at any point of time.

In addition to it the value in preserving film photography truly is in the storage and display. With so many of us storing photos exclusively in online libraries, on our Facebook accounts, etc., it's easy to lose track of some of the most important pictures that define chapters in our lives. As we grow older and move on in life, photos in these sorts of digital libraries can simply be left behind, whereas those placed carefully in themed albums and photo frames can be stored, handed down, etc. Convenience is wonderful, but the value of photography is in strategic – rather than easy – storage and display.

In addition to storing photos it is sometimes important to create a memory by collecting all the photos which can help them remember all the moments spent.   Further students enrolled in this minor will have pastime activity to recreate their memories in the form of short film / documentary. They will get the essential skills of editing, production and direction.

This minor introduces the basics of photography and film making. It deals with the basics of photography and introduces professional and specializations in photography. It concludes with the film making such as how to produce, direct a short film.
The different subjects offered under photography and digital film making are:
   a) Basics of Photography
   b) Introduction to Professional Photography
   c) Specializations in Photography
   d) Digital Film making
   e) Making the Film and Portfolio – Project

Course Code	Course Title	L	T	P	C
22SA906	Basics of Photography	2	0	4	4
22SA907	Professional Photography	2	0	4	4
22SA908	Specializations in Photography	2	0	4	4
22SA909	Digital Film making	2	0	4	4
22SA910	Making the Film and Portfolio - Project	2	0	4	4

22SA906-BASICS OF PHOTOGRAPHY

PREREQUISITE KNOWLEDGE: Nil

COURSE DESCRIPTION AND OBJECTIVES:

This course provides a basic insight on various technical aspects of camera, colour and composition. It helps the learner to understand and process the technique of image capturing.

MODULE 1

UNIT 1   6L+0T+12P = 18 Hours
INTRODUCING CAMERA
Understanding the camera: Technical aspects, creative possibilities and its limitations
Aesthetics of Photography: study on colour and composition and how it impacts an image.
History of photography: How the process of creating images has evolved over the years and along with it, the aesthetics.

UNIT 2   10L+0T+20P = 30 Hours
NATURAL LIGHT AND FILTERS
Applying the technical concepts for in-depth study of natural light and its quality. Different ways to add mood and dimension for an image using natural light. Filters and their applications in manipulating images captured.

MODULE 2

UNIT 1   6L+0T+12P = 18 Hours
EXPOSURE AND COMPOSITION
Exposure triangle: ISO, Aperture and Shutter speed. Composition: The Rule of Thirds, balance & Symmetry, perspective & angle. Focus and depth of field, Camera anatomy, white balance and colour, equipment's of camera

UNIT 2   10L+0T+20P = 30 Hours
TECHNICAL ASPECTS OF PHOTOGRAPHY
Leading lines, Balance and symmetry, creating depth with layering, Camera scene modes, using shapes in compositions, shooting portraits with a wide lens Vs. telephoto lens, Photo resolution, essentials of processing RAW files and image editing, HDR and Bracketing, reading exposure with histogram.

SKILLS:
- To develop the skill & knowledge of Digital Photography.
- Students will understand the knowhow and can function either as an entrepreneur or can take up jobs in Photography & video studios, edit set- up, graphic arts industry and other audio visual sectors.
- Develop the method of basic image editing techniques.
- Develop the concept of digital output and producing the final product.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Able to understand the color composition and how it affects the image	Analyze	1,2	1,2,6,9
2	Able to apply the natural light and the filters	Apply	1,2	1,2,9,12
3	Apply the exposure triangle	Apply	2	1,2,3,9,12
4	Evaluate the histogram	Evaluate	2	1,2,9,12
5	Able to apply the editing knowledge for a raw file	Create	1	1,2,3,9,12

TEXT BOOKS:
1. Phillip Krejcarek, "Digital Photography-A hands on Introduction", Delmer Publishers.
2. Adrian Davies and Phill Fennessy, "Digital for photographers", Focal Press.

REFERENCE BOOKS:

1. Jon Torrant," Understanding Digital Cameras", Focal Press.
2. Carla Rose," Teach Yourself Digital Photography in 14 Days", Techmedia, 1997

Image source
https://www.magzter.com/IN/Next-Gen-Publishing-Ltd/BASICS-OF-PHOTOGRAPHY/Photography/
Image filename
Basics of photography

22SA907-PROFESSIONAL PHOTOGRAPHY

PREREQUISITE KNOWLEDGE: Basics of Photography

COURSE DESCRIPTION AND OBJECTIVES: This course provides a basic insight on the lighting and its importance in photography. It helps the learner to understand and process the different equipment related to the lenses and its accessories.

MODULE 1

UNIT 1   **6L+0T+12P= 18 Hours**
LIGHTING AND FLASH PHOTOGRAPHY
lighting, shooting in Natural light, Artificial light, shooting with camera's flash and external flash. Using flash outdoors, silhouettes and the back light, Artistic flares, getting rid of glare in glasses

UNIT 2   **10L+0T+20P= 30 Hours**
NATURAL LIGHT AND FILTERS
Practise with Natural lights and Artificial light, Soft Vs. Hard light, 3-point lighting setup, understanding technical aspects and usage of Studio lights, Light modifying accessories, light concepts used in still life, product and people photography

MODULE 2

UNIT 1   **6L+0T+12P= 18 Hours**
EQUIPMENT: LENSES & ACCESSORIES
Focal length, advanced understanding about Aperture, Prime Vs. Zoom lenses, Kit Vs. Pro lens, Lens stabilization, Lens filters, Chromatic aberration, Cleaning the camera lens, Accessories – memory cards, battery & chargers, stabilisation, flashes and lighting, camera cases and bags.

UNIT 2   **10L+0T+20P= 30 Hours**
TILT SHIFT LENSES AND POST PROCESSING
Tilt shift lenses – understanding the different movements possible with tilt shift lenses and its applications in various areas of photography, Macro lens, Fish eye lens, Image editing, composting and basics of retouching.

SKILLS:
- Able to remove glares from glasses.
- Able to differentiate between natural and artificial light.
- Cleaning the camera lens.
- Able to edit an image.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand about the focal length.	Analyze	1,2	1,2,6,9
2	Know about aperture and solve the problem in camera.	Apply	1,2	1,2,9,12
3	Apply the concepts of cleaning the camera lens.	Apply	2	1,2,3,9,12
4	Examine the image for editing.	Evaluate	2	1,2,9,12
5	Acquire the knowledge of retouching.	Create	1	1,2,3,9,12

TEXT BOOKS:
1. Phillip Krejcarek, "Digital Photography-A hands on Introduction", Delmer Publishers.
2. Adrian Davies and Phill Fennessy, "Digital for photographers", Focal Press.

REFERENCE BOOKS:

1. Jon Torrant," Understanding Digital Cameras", Focal Press.
2. Carla Rose," Teach Yourself Digital Photography in 14 Days", Techmedia, 1997

Image source
https://blog.upskillist.com/10-signs-you-are-ready-to-become-a-professional-photographer/
Image filename
Professional photography

22SA908-SPECIALIZATIONS IN PHOTOGRAPHY

PREREQUISITE KNOWLEDGE: Basics of Photography, Professional Photography

COURSE DESCRIPTION AND OBJECTIVES: This course provides a basic insight on the lighting and its importance in photography. It helps the learner to understand and process the different equipment related to the lenses and its accessories.

MODULE 1

UNIT 1   **6L+0T+12P= 18 Hours**
BASIC TYPES IN PHOTOGRAPHY
Portrait photography, landscape photography, low light photography, Sports & Action photography, Architecture and Street photography, wild life photography and Macro photography.

UNIT 2   **10L+0T+20P= 30 Hours**
COMMUNICATION THROUGH PHOTOGRAPHY
Developing a strong creative strategy and working with well-defined creative brief, understanding to communicate effectively, Practising various types of photography, understanding the appropriate lens used for particular type of photography. Sample shoots and assignments of each photography type.

MODULE 2

UNIT 1   **6L+0T+12P =18 Hours**
COMMERCIAL AND ADVANCED PHOTOGRAPHY
Product photography, Event & Wedding photography, long exposure photography, Night photography, Time-lapse photography, Aerial & Drone photography

UNIT 2   **10L+0T+20P= 30 Hours**
PRACTISING COMMERCIAL PHOTOGRAPHY
Measures to be taken for conceptualising product and its branding, demonstration of product photography, steps to follow while planning an event or wedding photography, Demonstration on – long exposure, night photography, time lapse, Introduction to Aerial and Drone photography.

SKILLS:
- ➢ Develop portrait photography
- ➢ Develop landscape photography.
- ➢ Design aerial photography.
- ➢ Design drone photography.
- ➢ Develop time lapse photography.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the difference between portrait and landscape photography.	Analyze	1,2	1,2,6,9
2	Apply the appropriate lens in photography	Apply	1,2	1,2,9,12
3	Apply the concept of long exposure photography in event	Apply	2	1,2,3,9,12
4	Examine the different lens and aperture.	Evaluate	2	1,2,9,12
5	Acquire the knowledge of aerial photography.	Create	1	1,2,3,9,12

TEXT BOOKS:
1. Phillip Krejcarek, "Digital Photography-A hands on Introduction", Delmer Publishers.
2. Adrian Davies and Phill Fennessy, "Digital for photographers", Focal Press

REFERENCE BOOKS:

3. Jon Torrant," Understanding Digital Cameras", Focal Press.
4. Carla Rose," Teach Yourself Digital Photography in 14 Days", Techmedia, 1997.

Image source
https://www.seamedu.com/blog/choosing-a-photography-specialisation-what-you-should-know/
Image filename
Specializations in photography

22SA909-DIGITAL FILM MAKING

PREREQUISITE KNOWLEDGE: Basics of Photography, Professional Photography

COURSE DESCRIPTION AND OBJECTIVES: This course provides a basic insight on the different formats of film making such as narrative, documentary. It helps the learner to understand the various process involved in film making such as script writing, production.

MODULE 1

UNIT 1   **6L+0T+12P=18 Hours**
INTRODUCTION TO MEDIUM OF FILMS
Different formats of film making – narrative, documentaries, short films. Introduction to the concept of shots, scene, sequence.

UNIT 2   **10L+0T+20P = 30 Hours**
ASPECTS OF FILMS
Script writing, production, location scouting, directing and editing, The making of a film – from shoot to edit to sound, Demonstration through case studies, critically acclaimed films.

MODULE 2

UNIT 1   **6L+0T+12P = 18 Hours**
INTRODUCTION TO FILM MAKING
Direction – camera – editing – sound, understanding and exploring the role of Director, the DOP, and the role of Editing and sound.

UNIT 2   **10L+0T+20P= 30 Hours**
TECHNICAL ASPECT OF FILM MAKING
Filming: Exploring framing, lenses, lighting (natural and artificial), language of shots and camera and movements.
Editing: Introduction to software rushes conversion from raw file to low resolution files, syncing, sorting and creating a project.
Sound: sound recording on camera and on recorder. Sound design.

SKILLS:
- Distinguish between narrative and documentary film.
- Develop a script.
- Design a location for shooting.
- Demonstrate through case study.
- Direct a film.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the narrative, documentary and short film.	Analyze	1,2	1,2,6,9
2	Analyze the process of making a film from shot to sound	Apply	1,2	1,2,9,12
3	Apply the concepts of direction for directing a short film.	Apply	2	1,2,3,9,12
4	Examine the filming techniques.	Evaluate	2	1,2,9,12
5	Acquire the knowledge of editing for editing a short film.	Create	1	1,2,3,9,12

TEXT BOOKS:
1. Phillip Krejcarek, "Digital Photography-A hands on Introduction", Delmer Publishers.
2. Adrian Davies and Phill Fennessy, "Digital for photographers", Focal Press

REFERENCE BOOKS:

1. Jon Torrant," Understanding Digital Cameras", Focal Press.
2. Carla Rose," Teach Yourself Digital Photography in 14 Days", Techmedia, 1997.

Image source:
https://feelmyworth.com/digital-filmmaking-2021/
Image filename:
Digital film making

MINOR ON PRACTICES IN COMPUTING
Offered by Department of Training and Placements

Practices in Computing minor program is aimed to transform the budding engineer industry ready. Through these courses, students will undergo all the necessary building blocks of IT Employment stack which include Problem Solving, Full Stack Development, Software Testing and Automation.

This minor program mainly emphasizes on practice, and aimed to provide an opportunity to the students to build Web/ Mobile Applications by using Front-end development languages such as HTML, CSS, JavaScript, React and Bootstrap and back-end technologies include SQL, Mongo DB, Node JS etc. These courses, further, help the Students to adopt and enforce Continuous Integration and Continuous delivery as best practices and also able to write an automated functional test for both front-end and back-end tools and technologies.

Course Code	Course Title	L	T	P	C
22TP901	Advanced Java	0	1	3	2
22TP902	Database Systems	0	1	3	2
22TP904	Internet Technologies	0	1	3	2
22TP906	Introduction to Micro Services & DevOps	0	1	3	2
22TP909	Mobile Application Development	0	1	3	2
22TP911	Robotic Process Automation	0	1	3	2
22TP912	Software Testing Automation Tools	0	1	3	2
22TP913	Object Oriented Programming	0	1	3	2
22TP914	Capstone Project	0	2	6	4
22TP915	Internship	0	2	6	4

R22 B.Tech.
4YEAR
DEGREE
PROGRAMME

COURSE STRUCTURE - R22

Department Electives

Course Code	Course Title	L	T	P	C
22ME801	3D Printing and Design	2	2	0	3
22ME802	Advance Plastic Processing	2	2	0	3
22ME803	Advanced Engine Technology	2	2	0	3
22ME804	Asset Management	2	2	0	3
22ME805	Automation and Advanced Manufacturing Processes	2	2	0	3
22ME806	Biomechanics	2	2	0	3
22ME807	Ceramics, Polymers and Smart Materials	2	2	0	3
22ME808	Composite Materials	2	2	0	3
22ME809	Computational Fluid Dynamics	2	2	0	3
22ME810	Computational Material Science	2	2	0	3
22ME811	Computational Multibody Dynamics	2	2	0	3
22ME812	Cryogenics	2	2	0	3
22ME813	Design and Fabrication of Composite Materials	2	2	0	3
22ME814	Design of Smart Actuators	2	2	0	3
22ME815	Digital Manufacturing	2	2	0	3
22ME816	Electronics and Aerospace Materials	2	2	0	3
22ME817	Energy Audit and Management	2	2	0	3
22ME818	Environmental Degradation and Bio Materials	2	2	0	3
22ME819	Failure Analysis	2	2	0	3
22ME820	Fuels and Combustion Technology	2	2	0	3
22ME821	Industrial Economics	2	2	0	3
22ME822	Industrial Engineering and Estimating & Costing	2	2	0	3
22ME823	Industrial Engineering and Production Management	2	2	0	3
22ME824	IOT and Smart Manufacturing	2	2	0	3
22ME825	Jet and Rocket Propulsions	2	2	0	3
22ME826	Metrology and Surface Engineering	2	2	0	3
22ME827	Modelling and Simulation of Manufacturing Systems	2	2	0	3
22ME828	Nano material synthesis and Characterization Techniques	2	2	0	3
22ME829	Non Destructive Testing	2	2	0	3
22ME830	Product Design for Manufacturing	2	2	0	3
22ME831	Refrigeration and Air-Conditioning	2	2	0	3

22ME832	Special Casting and Welding Technologies	2	2	0	3
22ME833	Tribology	2	2	0	3
22ME834	Value Engineering	2	2	0	3
22ME835	Waste Management and Energy Generation Technologies	2	2	0	3

Honors - Automotive Engineering

Course Code	Course Title	L	T	P	C
22ME951	Automotive Aerodynamics	3	2	0	4
22ME952	Automotive Electrical and Electronics	3	2	0	4
22ME953	Automotive Safety	3	2	0	4
22ME954	Engine and Vehicle Management System	3	2	0	4
22ME955	Hybrid and Electric Vehicles	3	2	0	4

Honors - Energy Engineering

Course Code	Course Title	L	T	P	C
22ME956	Bio Energy Engineering	3	2	0	4
22ME957	Hydrogen Energy and Fuel Cells	3	2	0	4
22ME958	Renewable Power Generation Technology	3	2	0	4
22ME959	Solar Energy Engineering	3	2	0	4
22ME960	Energy Storage Systems	3	2	0	4

R22 B.Tech.
4 YEAR
DEGREE PROGRAMME