OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OPEN ELECTIVES – I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OAS351	Space Science	OEC	3	0	0	3	3
2.	OIE351	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3.	OBT351	Food, Nutrition and Health	OEC	3	0	0	3	3
4.	OCE351	Environmental and Social Impact Assessment	OEC	3	0	0	3	3
5.	OEE351	Renewable Energy System	OEC	3	0	0	3	3
6.	OEI351	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
7.	OMA351	Graph Theory	OEC	3	0	0	3	3
8.	CCS355	Neural Networks and Deep Learning	OEC	2	0	2	4	3
9.	CCW332	Digital Marketing	OEC	2	0	2	4	3

OPEN ELECTIVES – II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OIE352	Resource Management Techniques	OEC	3	0	0	3	3
2.	OMG351	Fintech Regulation	OEC	3	0	0	3	3
3.	OFD351	Holistic Nutrition	OEC	3	0	0	3	3
4.	AI3021	IT in Agricultural System	OEC	3	0	0	3	3
5.	OEI352	Introduction to Control Engineering	OEC	3	0	0	3	3
6.	OPY351	Pharmaceutical Nanotechnology	OEC	3	0	0	3	3
7.	OAE351	Aviation Management	OEC	3	0	0	3	3
8.	CCS342	DevOps	OEC	2	0	2	4	3
9.	CCS361	Robotic Process Automation	OEC	2	0	2	4	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
3.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
4.	CME365	Renewable Energy Technologies	OEC	3	0	0	3	3
5.	OME354	Applied Design Thinking	OEC	3	0	0	3	3
6.	MF3003	Reverse Engineering	OEC	3	0	0	3	3
7.	OPR351	Sustainable Manufacturing	OEC	3	0	0	3	3
8.	AU3791	Electric and Hybrid Vehicles	OEC	3	0	0	3	3
9.	OAS352	Space Engineering	OEC	3	0	0	3	3
10.	OIM351	Industrial Management	OEC	3	0	0	3	3
11.	OIE354	Quality Engineering	OEC	3	0	0	3	3
12.	OSF351	Fire Safety Engineering	OEC	3	0	0	3	3
13.	OML351	Introduction to non-destructive testing	OEC	3	0	0	3	3
14.	OMR351	Mechatronics	OEC	3	0	0	3	3
15.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
16.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3
17.	OGI351	Remote Sensing Concepts	OEC	3	0	0	3	3
18.	OAI351	Urban Agriculture	OEC	3	0	0	3	3
19.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3
20.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OCH351	Nano Technology	OEC	3	0	0	3	3
23.	OCH352	Functional Materials	OEC	3	0	0	3	3
24.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3

25.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
26.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
27.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
28.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
29.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
30.	OPE351	Introduction to Petroleum Refining and Petrochemicals	OEC	3	0	0	3	3
31.	CPE334	Energy Conservation and Management	OEC	3	0	0	3	3
32.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
33.	OEC351	Signals and Systems	OEC	3	0	0	3	3
34.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
35.	OMA352	Operations Research	OEC	3	0	0	3	3
36.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
37.	OMA354	Linear Algebra	OEC	3	0	0	3	3
38.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3
39.	OBT352	Basics of Microbial Technology	OEC	3	0	0	3	3
40.	OBT353	Basics of Biomolecules	OEC	3	0	0	3	3
41.	OBT354	Fundamentals of Cell and Molecular Biology	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
3.	OMA356	Random Processes	OEC	3	0	0	3	3
4.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
5.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
6.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
7.	OME352	Additive Manufacturing	OEC	3	0	0	3	3
8.	CME343	New Product Development	OEC	3	0	0	3	3
9.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	3	0	0	3	3
10.	MF3010	Micro and Precision Engineering	OEC	3	0	0	3	3
11.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
12.	AU3002	Batteries and Management system	OEC	3	0	0	3	3
13.	AU3008	Sensors and Actuators	OEC	3	0	0	3	3
14.	OAS353	Space Vehicles	OEC	3	0	0	3	3
15.	OIM352	Management Science	OEC	3	0	0	3	3
16.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
17.	OIE353	Operations Management	OEC	3	0	0	3	3

18.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
19.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
20.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3
21.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
22.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
23.	OMR353	Sensors	OEC	3	0	0	3	3
24.	ORA352	Concepts in Mobile Robots	OEC	3	0	0	3	3
25.	MV3501	Marine Propulsion	OEC	3	0	0	3	3
26.	OMV351	Marine Merchant Vessels	OEC	3	0	0	3	3
27.	OMV352	Elements of Marine Engineering	OEC	3	0	0	3	3
28.	CRA332	Drone Technologies	OEC	3	0	0	3	3
29.	OGI352	Geographical Information System	OEC	3	0	0	3	3
30.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
31.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
32.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
33.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
34.	OCH353	Energy Technology	OEC	3	0	0	3	3
35.	OCH354	Surface Science	OEC	3	0	0	3	3
36.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
37.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
38.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
39.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
40.	FT3201	Fibre Science	OEC	3	0	0	3	3
41.	OTT355	Garment Manufacturing Technology	OEC	3	0	0	3	3
42.	OPE353	Industrial safety	OEC	3	0	0	3	3
43.	OPE354	Unit Operations in Petro Chemical Industries	OEC	3	0	0	3	3
44.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
45.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
46.	OEC353	VLSI Design	OEC	3	0	0	3	3
47.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
48.	OBT355	Biotechnology for Waste Management	OEC	3	0	0	3	3
49.	OBT356	Lifestyle Diseases	OEC	3	0	0	3	3
50.	OBT357	Biotechnology in Health Care	OEC	3	0	0	3	3

Using Slide master, notes and handout master

Working with animation and transitions

Organize and Group slides

Import or create and use media objects: audio, video, animation

Perform slideshow recording and Record narration and create presentable videos

TOTAL: 30 PERIODS

COURSE OUTCOMES:

On successful completion the students will be able to

CO1:Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
CO2:Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
CO3:Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

MA3355	**RANDOM PROCESSES AND LINEAR ALGEBRA**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

COURSE OBJECTIVES :

- To introduce the basic notions of vector spaces which will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations , inner product spaces and orthogonalization..
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To provide necessary basics in probability that are relevant in applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random
- variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.

UNIT - I: PROBABILITY AND RANDOM VARIABLES **9 + 3**

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable.

UNIT - II: TWO - DIMENSIONAL RANDOM VARIABLES **9 + 3**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT – III: RANDOM PROCESSES **9 + 3**

Classification – Stationary process – Markov process - Poisson process - Discrete parameter Markov chain – Chapman Kolmogorov equations (Statement only) - Limiting distributions .

UNIT - IV: VECTOR SPACES 9 + 3

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT - V: LINEAR TRANSFORMATION AND INNER PRODUCT SPACES 9 + 3

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Inner product - Norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

TOTAL : 60 PERIODS

COURSE OUTCOMES :

Upon successful completion of the course, students will be able to:

CO1:Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.

CO2:Demonstrate accurate and efficient use of advanced algebraic techniques.

CO3:Apply the concept of random processes in engineering disciplines.

CO4:Understand the fundamental concepts of probability with a thorough knowledge of standard distributions that can describe certain real-life phenomenon.

CO5:Understand the basic concepts of one and two dimensional random variables and apply them to model engineering problems.

TEXT BOOKS :

1. Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., “Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014.
2. Ibe, O.C., “Fundamentals of Applied Probability and Random Processes", Elsevier,1st Indian Reprint, 2007.
3. Friedberg. A.H., Insel. A.J. and Spence. L., “Linear Algebra”, Prentice Hall of India, New Delhi, 4th Edition, 2004.

REFERENCE BOOKS :

1. Hsu, "Schaum’s Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
2. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
3. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
4. Kolman. B. Hill. D.R., “Introductory Linear Algebra”, Pearson Education, New Delhi, First Reprint, 2009.
5. Kumaresan. S., “Linear Algebra – A Geometric Approach”, Prentice – Hall of India, New Delhi, Reprint, 2010.
6. Strang. G., “Linear Algebra and its applications”, Thomson (Brooks/Cole), New Delhi, 2005.

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
2	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
3	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
4	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-

5	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
AVg.	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

BM3491 BIOMEDICAL INSTRUMENTATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements.
- To understand the characteristics of Bio signals.
- To understand the design of bioamplifiers
- To explain the different techniques used for measurement of non-electrical bio-parameters
- To explain the biochemical measurement techniques as applicable for diagnosis and treatment.

UNIT I ELECTRODE CONFIGURATIONS 9

Bio signals characteristics – Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

UNIT II BIOSIGNAL CHARACTERISTICS 9

Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven's triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.

UNIT III BIOAMPLIFIERS 9

Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference

UNIT IV MEASUREMENT OF BIO SIGNALS 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements

UNIT V BIOCHEMICAL MEASUREMENTS 9

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

OPEN ELECTIVE I

OAS351	SPACE SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the space environment and their effects.
- To extend the origin of universe and development.
- To classify the galaxies and their evolution.
- To interpret the variable stars in the galaxies.
- To explain theory of formation of our solar system.

UNIT I INTRODUCTION 9

Introduction to space science and applications – historical development – Space Environment-Vacuum and its Effects, Plasma & Radiation Environments and their Effects, Debris Environment and its Effects - Newton's Law of gravitation – Fundamental Physical Principles.

UNIT II ORIGIN OF UNIVERSE 9

Early history of the universe – Big-Bang and Hubble expansion model of the universe – cosmic microwave background radiation – dark matter and dark energy.

UNIT III GALAXIES 7

Galaxies, their evolution and origin – active galaxies and quasars – Galactic rotation – Stellar populations – galactic magnetic field and cosmic rays.

UNIT IV STARS 10

Stellar spectra and structure – stellar evolution – Nucleo-synthesis and formation of elements – Classification of stars – Harvard classification system – Hertsprung-Russel diagram – Luminosity of star – variable stars – composite stars (white dwarfs, Neutron stars, black hole, star clusters, supernova and binary stars) – Chandrasekhar limit.

UNIT V SOLAR SYSTEM 10

Nebular theory of formation of our Solar System – Solar wind and nuclear reaction as the source of energy – Sun and Planets: Brief description about shape size – period of rotation about axis and period of revolution – distance of planets from sun – Bode's law – Kepler's Laws of planetary motion – Newton's deductions from Kepler's Laws – correction of Kepler's third law – determination of mass of earth – determination of mass of planets with respect to earth – Brief description of Asteroids – Satellites and Comets.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Obtain a broad, basic knowledge of the space sciences.

CO2: Explain the scientific concepts such as evolution by means of natural selection, age of the Earth and solar system and the Big-Bang.

CO3: Describe the main features and formation theories of the various types of observed galaxies, in particular the Milky Way.

CO4: Explain stellar evolution, including red giants, supernovas, neutron stars, pulsars, white dwarfs and black holes, using evidence and presently accepted theories;

CO5: Describe the presently accepted formation theories of the solar system based upon observational and physical constraints;

TEXT BOOKS:

1. Hess W., "Introduction to Space Science", Gordon & Breach Science Pub; Revised Ed., 1968.
2. Krishnaswami K. S., "Astrophysics: A modern Perspective", New Age International, 2006.

REFERENCES:

1. Arnab Rai Choudhuri, "Astrophysics for Physicists", Cambridge University Press, New York, 2010.
2. Krishnaswami K. S., "Understanding cosmic Panorama", New Age International, 2008.

OIE351 INTRODUCTION TO INDUSTRIAL ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

The objective of this course is to provide foundation in Industrial Engineering in order to enable the students to make significant contributions for improvements in diverse organizations.

- Explain the concepts productivity and productivity measurement approaches.
- Explain the basic principles in facilities planning and plant location.
- Apply work study and ergonomic principles to design workplaces for the improvement of human performance
- Impart knowledge to design and implement Statistical Process control in any industry.
- Recognize the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages

UNIT I INTRODUCTION 9

Concepts of Industrial Engineering – History and development of Industrial Engineering – Roles of Industrial Engineer – Applications of Industrial Engineering – Production Management Vs Industrial Engineering – Production System – Input Output Model – Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds of Productivity measures.

UNIT II PLANT LOCATION AND LAYOUT 9

Factors affecting Plant location – COURSE OBJECTIVES of Plant Layout – Principles of Plant Layout – Types of Plant Layout – Methods of Plant and Facility Layout – Storage Space requirements – Plant Layout procedure – Line Balancing methods.

UNIT III WORK SYSTEM DESIGN& ERGONOMICS 9

Need – COURSE OBJECTIVES – Method Study procedure – Principles of Motion Economy – Work

Measurement procedures – Time Study –Work sampling- Ergonomics and its areas of application in the work system - Physical work load and energy expenditure, Anthropometry – measures – design procedure, Work postures-sitting, standing.

UNIT IV STATISTICAL QUALITY CONTROL 9

Definition and Concepts – Fundamentals – Control Charts for variables – Control Charts for attributes – Acceptance Sampling- O.C curve –Single sampling plan- Double sampling plan.

UNIT V PRODUCTION PLANNING AND CONTROL 9

Forecasting – Qualitative and Quantitative forecasting techniques – Types of production – Process planning – Economic Batch Quantity– Loading – Scheduling and control of production – Dispatching–Progress control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, Students will be able to

CO1: Ability To define the concepts of productivity and productivity measurement approaches.

CO2: Ability to evaluate appropriate location models for various facility types and design various facility layouts

CO3: Ability To conduct a method study and time study to improve the efficiency of the system.

CO4: Ability to Control the quality of processes using control charts in manufacturing/service industries.

CO5: Ability to define the Planning strategies and Material Requirement Plan.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2											1		1	
2	2	2	3	2											
3	2	2	2	1	1			2			1		2		
4	2	2	3	1	1										
5	1	2	2									1			3
AVg.	2.2	2	2.5	1.3	1			2			1	1	2	1	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

TEXT BOOK:

1. O.P.Khanna, 2010, Industrial Engineering and Management, Dhanpat Rai Publications.

REFERENCES:

1. Ravi Shankar, 2009, Industrial Engineering and Management, Galgotia Publications & Private Limited.
2. Martand Telsang,2006, Industrial Engineering and Production Management, S. Chand and Company

OBT351 FOOD, NUTRITION AND HEALTH L T P C

3 0 0 3

COURSE OBJECTIVES:

- Build knowledge and an overview on general aspects of nutrition and health.
- Distinguish the nutritive value of various food items, BMI calculation differentiating super junk, and functional foods in the market.
- To Solve the real-world problems based on nutrition and health

UNIT-I FOOD AND MICROBIOLOGY OF HEALTH: 9

Food resources (plant, animal, microbes); Overview of current production systems; constraints and

necessity of novel strategies. Functional and “Super” Foods - role in optimal nutrition. Sugar, protein and fat substitutes. Food and behaviour- physiological disturbances in alcoholism, drug abuse and smoking. Food Related Laws: Inspection – Microbial Indicators of product quality – Indicators of food safety – 229 Microbiological safety of foods - control strategies – Hazard Analysis Critical Point System (HACCP concept)- Microbiological criteria.

UNIT-II NUTRIENTS AND FOOD ADDITIVES: 9

Macro nutrients- carbohydrates, proteins and lipids. Micronutrients-Minerals: Calcium, Magnesium, Iron, Zinc, Copper and Selenium; Vitamins. Nutritional Physiology**:** Digestion, absorption, and utilization of major and minor nutrients. Biotechnology of food additives- Bioflavors and colors, microbial polysaccharides, recombinant enzymes in food sector.

UNIT-III NANO FOOD TECHNOLOGY: 9

Nano materials as food components, food packaging and nano materials, policies on usage of nanomaterials in foods. Food product development: steps involved in food product development, shelf-life assessment.

UNIT-IV FOOD RELATED NUTRITIONAL DISORDERS AND ENERGY CALCULATION: 9

Type I Disorders-Causes of life style and stress related diseases. Cardio-vascular diseases, hypertension, obesity. Type-II Disorders: Cancer, diabetics, ulcers, electrolyte and water imbalance. Health indices. Preventive and remedial measures. Energy balance and methods to calculate individual nutrient and energy needs. Planning a healthy diet.

UNIT-V CONSUMERS ON GM FOODS AND CONTEMPORARY ISSUES: 9

Global perspective of consumers on GM foods; Major concerns of transgenic, foods GM ingredients in food products. (labeling, bioavailability, safety aspects); regulatory agencies involved in GM foods, Case studies- GM foods.

TOTAL:45 PERIODS

TEXT BOOK(S):

1. P.J. Fellows.2009. Food Processing Technology -Principles and Practice (Third Edition). A volume in Woodhead Publishing Series in Food Science, Technology and Nutrition.
2. Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto, Robert E. Levin. 2015. Food Biotechnology. CRC Press. Second edition.

REFERENCE BOOKS:

1. Understanding Nutrition. 2010. Ellie Whitney, Sharon Rady Rolfes, 11e. Thompson Wadsworth. 2.
2. Nutritional Sciences- From Fundamentals to Food.2013. Michelle McGuire, Kathy A. Beerman, 2 nd e. Thompson Wadsworth.
3. Yasmine Motarjemi, Huub Lelieveld, Food Safety Management - A Practical Guide for the Food Industry (2014), 1st Edition, Academic Press, London, UK

EXPECTED COURSE OUTCOME:

1.To be able to understand the nutritional values of the various types of foods

2.To be able to Analyze the role of food in the metabolic activity of the healthy diet

3. To be able to Infer the BMI calculation and stress related diseases.

4. To be able to Elaborate the independent decision on the choice of food to prevent life style disorders and diseases

5. To be able to Assess about the food laws governance

6. To be able to Compare junk, modified and super foods

OCE351 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT L T P C
3 0 0 3

COURSE OBJECTIVE:

- To impart the knowledge and skills to identify, assess and mitigate the environmental and social impacts of developmental projects

UNIT I INTRODUCTION 9

Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework–Stakeholders and their Role in EIA– Selection & Registration Criteria for EIA Consultants

UNIT II ENVIRONMENTAL ASSESSMENT 9

Screening and Scoping in EIA – Drafting of Terms of Reference,Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction – Analysis of alternatives

UNIT III ENVIRONMENTAL MANAGEMENT PLAN 9

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Public Hearing-Environmental Clearance Post Project Monitoring

UNIT IV SOCIO ECONOMIC ASSESSMENT 9

Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis-

UNIT V CASE STUDIES 9

EIA case studies pertaining to Infrastructure Projects – Real Estate Development - Roads and Bridges – Mass Rapid Transport Systems - Ports and Harbor – Airports - Dams and Irrigation projects - Power plants – CETPs- Waste Processing and Disposal facilities – Mining Projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students completing the course will have ability to

- carry out scoping and screening of developmental projects for environmental and social assessments

- explain different methodologies for environmental impact prediction and assessment
- plan environmental impact assessments and environmental management plans
- evaluate environmental impact assessment reports

TEXTBOOKS:

1. Canter, R.L, "Environmental impact Assessment ", 2nd Edition, McGraw Hill Inc, New Delhi,1995.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 – Overview, Asian Development Bank,1997.
3. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers,2009.

REFERENCES:

1. Becker H. A., Frank Vanclay,"The International handbook of social impact assessment" conceptual and methodological advances, Edward Elgar Publishing, 2003.
2. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.

OEE351 RENEWABLE ENERGY SYSTEM L T P C
3 0 0 3

COURSE OBJECTIVES:

- To Provide knowledge about various renewable energy technologies
- To enable students to understand and design a PV system.
- To provide knowledge about wind energy system.
- To Provide knowledge about various possible hybrid energy systems
- To gain knowledge about application of various renewable energy technologies

UNIT I INTRODUCTION 9

Primary energy sources, renewable vs. non-renewable primary energy sources, renewable energy resources in India, Current usage of renewable energy sources in India, future potential of renewable energy in power production and development of renewable energy technologies.

UNIT II SOLAR ENERGY 9

Solar Radiation and its measurements, Solar Thermal Energy Conversion from plate Solar Collectors, Concentrating Collectors and its Types, Efficiency and performance of collectors,. Direct Solar Electricity Conversion from Photovoltaic, types of solar cells and its application of battery charger, domestic lighting, street lighting, and water pumping, power generation schemes. Recent Advances in PV Applications: Building Integrated PV, Grid Connected PV Systems,

UNIT III WIND ENERGY 9

Wind energy principles, wind site and its resource assessment, wind assessment, Factors influencing wind, wind turbine components, wind energy conversion systems (WECS), Classification of WECS devices, wind electric generating and control systems, characteristics and

applications.

UNIT IV BIO-ENERGY 9

Energy from biomass, Principle of biomass conversion technologies/process and their classification, Bio gas generation, types of biogas plants, selection of site for biogas plant, classification of biogas plants, Advantage and disadvantages of biogas generation, thermal gasification of biomass, biomass gasifies, Application of biomass and biogas plants and their economics.

UNIT V OTHER TYPES OF ENERGY 9

Energy conversion from Hydrogen and Fuel cells, Geo thermal energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants and their economics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course students will be able to:

CO1: Attained knowledge about various renewable energy technologies
CO2: Ability to understand and design a PV system.
CO3: Understand the concept of various wind energy system.
CO4: Gained knowledge about various possible hybrid energy systems
CO5: Attained knowledge about various application of renewable energy technologies

REFERENCES

1. Twidell & Wier,**'**Renewable Energy Resources' CRC Press(Taylor & Francis).
2. Tiwari and Ghosal/ Narosa,'Renewable energy resources'.
3. D.P.Kothari, K.C.Singhal,'Renewable energy sources and emerging technologies', P.H.I.
4. D.S.Chauhan, S.K. Srivastava, 'Non – Conventional Energy Resources', New Age Publishers, 2006.
5. B.H.Khan, 'Non – Conventional Energy Resources', Tata Mc Graw Hill, 2006.

CO's-PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	2	3	3	3
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3
AVg.	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

OEI351 INTRODUCTION TO INDUSTRIAL INSTRUMENTATION AND CONTROL

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce common unit operations carried out in process industries.
- To impact knowledge about the important unit operations taking place in process industries.
- To prepare them to take up a case study on selected process industries like petrochemical industry, power plant industry and paper & pulp industry to make the students understand the different measurement and control techniques for important processes.
- Facilitate the students to apply knowledge to select appropriate measurement technique and control strategy for a given process.

UNIT - I COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -I 9

Unit Operation, Measurement and Control:-Transport of solid, liquid and gases - Evaporators – Crystallizers-Dryers.

UNIT -II COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II 9

Unit Operation, Measurement and Control: - Distillation – Refrigeration processes – Chemical reactors.

UNIT - III PROCESS MEASUREMENT AND CONTROL IN PETROCHEMICAL INDUSTRY 9

Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wet gas processing – Fractionation Column – Catalytic Cracking unit – Catalytic reforming unit

UNIT - IV PROCESS MEASUREMENT AND CONTROL IN THERMAL POWER PLANT INDUSTRY 9

Process flow diagram of Coal fired thermal Power Plant– Coal pulverizer - Deaerator – Boiler drum - Superheater – Turbines.

UNIT - V PROCESS MEASUREMENT AND CONTROL IN PAPER & PULP INDUSTRY 9

Process flow diagram of paper and pulp industry – Batch digestor – Continuous sulphatedigestor – Control problems on the paper machine.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

Study the characteristics of various processing units involved in chemical plant.
Develop the process model by using predefined unit operations (e.g. mixing, distillation, heating) from the library of any process simulator.
Analyse the functioning of each processing units with help of virtual unit operations packages.
Perform a physical property analysis using simulation packages
Implement distillation column analysis using simulation software.
Create process flow models and diagrams

COURSE OUTCOMES:

Students able to

CO1 understand common unit operations in process industries. L2

CO2 Identify the dynamics of important unit operations in petro chemical industry. L2

CO3 develop understanding of important processes taking place selected case studies namely petrochemical industry, power plant industry and paper & pulp industry. L5

CO4 Select appropriate measurement techniques for selective processes. L5

CO5 Develop controller structure based on the process knowledge. L5

CO6 Analyze the operation and challenges in integrated industrial processes. L4

TEXT BOOKS:

1. Balchen ,J.G., and Mumme, K.J., " Process Control structures and applications", Van Nostrand Reinhold Co., New York, 1988
2. Warren L. McCabe, Julian C. Smith and Peter Harriot, "Unit Operations of Chemical Engineering", McGraw-Hill International Edition, New York, Sixth Edition, 2001.

REFERENCES:

1. Liptak B.G., "Instrument and Automation Engineers' Handbook: Process Measurement and Analysis", Fifth Edition, CRC Press, 2016.
2. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, "Chemical ProcessEquipment: Selection and Design", Gulf Professional Publishing, 2010.
3. Austin G.T and Shreeves, A.G.T., "Chemical Process Industries", McGraw–Hill International student, Singapore, 1985.
4. Luyben W.C., "Process Modeling, Simulation and Control for Chemical Engineers", McGraw-Hill International edition, USA, 1989.
5. K. Krishnaswamy, Process Control, new age publishers , 2009.

List of Open Source Software/ Learning website:

1. https://www.aspentech.com/en
2. http://avtechscientific.com/
3. https://www.chemstations.com/CHEMCAD/
4. https://www.prosim.net/en/product/prosimplus-steady-state-simulation-and-optimization-of-processes/
5. https://www.cocosimulator.org/
6. https://dwsim.fossee.in/

CO's-PO's & PSO's MAPPING

PO,PSO CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	1					1		1					
CO2	3	3	1					1		1	2				2
CO3	3	3	1					1		1					
CO4	3	3	1	3	3			1		1			3	3	
CO5	3	3	3			3		1		1			3	3	3
CO6	3	3	2	3	2	1	2	1		2	1	1			2
Avg	3	3	1.5	3	2.5	2	2	1		1.16	1.5	1	3	3	2.33

1- low, 2-medium, 3-high, '-"- no correlation

OMA351 **GRAPH THEORY** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the graph models and basic concepts of graphs.
- To study the characterization and properties of trees and graph connectivity.
- To provide an exposure to the Eulerian and Hamiltonian graphs.
- To introduce Graph colouring and explain its significance.
- To provide an understanding of Optimization Graph Algorithms.

UNIT I INTRODUCTION TO GRAPHS 9

Graphs and Graph Models – Connected graphs – Common classes of graphs – Multi graphs and Digraphs – Degree of a vertex – Degree Sequence – Graphs and Matrices – Isomorphism of graphs.

UNIT II TREES AND CONNECTIVITY 9

Bridges – Trees – Characterization and properties of trees – Cut vertices – Connectivity.

UNIT III TRAVERSABILITY 9

Eulerian graphs – Characterization of Eulerian graphs – Hamiltonian graphs – Necessary condition for Hamiltonian graphs – Sufficient condition for Hamiltonian graphs.

UNIT IV PLANARITY AND COLOURING 9

Planar Graphs – The Euler Identity – Non planar Graphs – Vertex Colouring – Lower and Upper bounds of chromatic number.

UNIT V OPTIMIZATION GRAPH ALGORITHMS 9

Dijkstra's shortest path algorithm – Kruskal's and Prim's minimum spanning tree algorithms – Transport Network – The Max-Flow Min-Cut Theorem – The Labeling Procedure – Maximum flow problem.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of this course, the student will be able to

CO1: Apply graph models for solving real world problem.
CO2: Understand the importance the natural applications of trees and graph connectivity.
CO3: Understand the characterization study of Eulerian graphs and Hamiltonian graphs.
CO4: Apply the graph colouring concepts in partitioning problems.
CO5: Apply the standard optimization graph algorithms in solving application problems.

TEXT BOOKS

1. Gary Chatrand and Ping Zhang, "Introduction to Graph Theory", Tata McGraw – Hill companies Inc., New York, 2006.
2. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics, An applied introduction" Fifth edition, Pearson Education, Inc, Singapore, 2004.

REFERENCES

1. Balakrishnan R. and Ranganathan K., "A Text Book of Graph Theory", Springer – Verlag, New York, 2012.
2. Douglas B. West, "Introduction to Graph Theory", Pearson, Second Edition, New York, 2018.

CO's-PO's & PSO's MAPPING

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3												
CO2		2	2		2										
CO3		2	2	2						2					
CO4	2	2	2												
CO5		3	2		2					3					
CO6															

1 - low, 2 - medium, 3 - high, '-' - no correlation

CCS355 NEURAL NETWORKS AND DEEP LEARNING L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand the basics in deep neural networks
- To understand the basics of associative memory and unsupervised learning networks
- To apply CNN architectures of deep neural networks
- To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
- To apply autoencoders and generative models for suitable applications.

UNIT I INTRODUCTION 6

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction-Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT II ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS 6

Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

UNIT III THIRD-GENERATION NEURAL NETWORKS 6

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

UNIT IV DEEP FEEDFORWARD NETWORKS 6

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

UNIT V RECURRENT NEURAL NETWORKS 6

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders.

30 PERIODS

LAB EXPERIMENTS: 30 PERIODS

1. Implement simple vector addition in TensorFlow.
2. Implement a regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Improve the Deep learning model by fine tuning hyper parameters.
7. Implement a Transfer Learning concept in Image Classification.
8. Using a pre trained model on Keras for Transfer Learning
9. Perform Sentiment Analysis using RNN
10. Implement an LSTM based Autoencoder in TensorFlow/Keras.
11. Image generation using GAN

Additional Experiments:

12. Train a Deep learning model to classify a given image using pre trained model
13. Recommendation system from sales data using Deep Learning
14. Implement Object Detection using CNN
15. Implement any simple Reinforcement Algorithm for an NLP problem

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Apply Convolution Neural Network for image processing.
CO2: Understand the basics of associative memory and unsupervised learning networks.
CO3: Apply CNN and its variants for suitable applications.
CO4: Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
CO5: Apply autoencoders and generative models for suitable applications.

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications, 2021.

REFERENCES:

1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly, 2018.
2. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.
4. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018

5. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.
7. S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications”, PHI Learning, 2017.
8. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9. James A Freeman, David M S Kapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	3	1	-	-	2	1	-	-	2	2	1
2	3	1	2	1	-	-	-	-	-	1	2	2	-	1	-
3	3	3	3	3	3	1	-	-	2	1	-	-	2	2	1
4	3	3	3	3	3	-	-	-	2	-	2	3	2	2	2
5	1	1	3	2	3	-	-	-	2	-	-	-	1	1	-
AVg.	2.6	2	2.8	2.2	2.4	0.4	0	0	1.6	0.6	0.8	1	1.4	1.6	0.8

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

CCW332 DIGITAL MARKETING L T P C
2 0 2 3

COURSE OBJECTIVES:

- The primary objective of this module is to examine and explore the role and importance of digital marketing in today’s rapidly changing business environment.
- It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

UNIT I INTRODUCTION TO ONLINE MARKET 6

Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

UNIT II SEARCH ENGINE OPTIMISATION 6

Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement

UNIT III E- MAIL MARKETING 6

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting

UNIT IV SOCIAL MEDIA MARKETING 6

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.

UNIT V DIGITAL TRANSFORMATION 6

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aids its potential customer segments.
2. Perform keyword search for a skincare hospital website based on search volume and competition using Google keyword planner tool.
3. Demonstrate how to use the Google WebMasters Indexing API
4. Discuss an interesting case study regarding how an insurance company manages leads.
5. Discuss negative and positive impacts and ethical implications of using social media for political advertising.
6. Discuss how Predictive analytics is impacting marketing automation

COURSE OUTCOMES:

CO1: To examine and explore the role and importance of digital marketing in today's rapidly changing business environment..

CO2: To focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

CO3: To know the key elements of a digital marketing strategy.

CO4: To study how the effectiveness of a digital marketing campaign can be measured

CO5: To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

TOTAL:60 PERIODS

TEXT BOOKS

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education;
2. First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.
3. Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449
4. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
5. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited..
6. Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.
7. Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	3	-	-	-	1	2	3	3	3	3	3
2	2	2	2	1	3	-	-	-	1	2	3	3	3	3	3
3	1	1	1	2	2	-	-	-	1	2	1	1	3	2	1
4	3	2	2	3	1	-	-	-	1	3	2	3	2	3	2
5	2	3	1	3	3	-	-	-	2	3	1	2	1	2	1
AVg.	2.2	2.2	1.6	2	2.4	-	-	-	1.2	2.4	2	2.4	2.4	2.6	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

OPEN ELECTIVE II

OIE352 RESOURCE MANAGEMENT TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- Learn to formulate linear programming problems and solve LPP using simple algorithm
- Learn to solve networking problems
- Learn to formulate and solve integer programming problems
- Learn to solve Non Linear programming problems
- Learn to understand and solve project management problems

UNIT I LINEAR PROGRAMMING 9

Principal components of decision problem – Modeling phases – LP formulation and graphic solution – Resource allocation problems – simplex method – sensitivity analysis.

UNIT II DUALITY AND NETWORKS 9

Definition of dual problems – primal – Dual relationships – Dual simplex method –post optimality analysis – Transportation and assignment model – Shortest route problem.

UNIT III INTEGER PROGRAMMING 9

Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.

UNIT IV CLASSICAL OPTIMISATION THEROY: 9

Unconstrained external problems, Newton – Ralphson method – Equality constraints –Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.

UNIT V OBJECT SCHEDULOING: 9

Network diagram representation – Critical path method – Time charts and resource leveling – PERT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of the course, the students should be able to:

CO1 : Understand to formulate linear programming problems and solve LPP using simple algorithm

CO2 : Understand to solve networking problems

CO3 : Understand to formulate and solve integer programming problems

CO4 : Understand to solve Non Linear programming problems

CO5 : Understand to understand and solve project management problems

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		3	3	2									3	2	3
2		3	3	2									3	2	3
3		3	3	2									3	2	3
4		3	3	2									3	2	3
5		3	3	2									3	2	3
AVg.		3	3	2									3	2	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

TEXT BOOK:

1. H.A. Taha, “Operation Research”, Prentice Hall of India, 2002.

RFERENCES:

1. Paneer selvam, ‘Operations Research’ Prentice Hall of India, 2002.
2. Anderson ‘Quantitative Methods for Business’, 8th Edition, Thomson Learning, 2002.
3. Winston ‘Operations Research for Business’, Thomson Learning, 2003.
4. Vohra, ’Quantitative Techniques in Management’, Tata Mc Graw Hill, 2002.
5. Anand sarma, ‘Operation Research’ Himalaya Publishing House, 2003.

OMG351 FINTECH REGULATION L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To learn about Laws and Regulation
2. To acquire the knowledge of Regulations of Fintech firm and their role in Market

UNIT I INTRODUCTION 9

The Role of the Regulators, Equal Treatment and Competition, Need for a regulatory assessment of Fintech, India Regulations, The Risks to Consider, Regtech and SupTech, The rise of TechFins, Regulatory sandboxes, compliance and whistleblowing.

UNIT II INNOVATION AND REGULATION 9

The technology, market and the law, Regulation and Innovation in Banking and Finance, Regulations of Fintech Firms and their role in Market-Based Chains, Current Regulatory Approach, Fintech Innovations in Banking, Asset Management, Insurance, Pensions and Healthcare Schemes, Patentability of FinTech inventions.

UNIT III CROWDFUNDING AND DIGITAL ASSETS 9

Types of crowdfunding, The Jobs Act, Regulation crowdfunding, Regulation A+, Regulation D crowdfunding, Intrastate offerings, Digital Assets – Three uses of Digital Assets, A world of Altcoins, Stablecoins, Digital Asset Forks, Initial Coin Offerings, Regulatory Framework for Digital and Crypto Assets, Central Bank Digital Currencies.

UNIT IV MARKETPLACE LENDING AND MOBILE PAYMENTS 9

Online Lending Business Models, Payday Loans, Consumer Protection Laws, Debt Collection, Equal Credit Opportunity Act, Contract Formation and the E-Sign Act, Military Lending Act, Securities Laws Considerations, Mobile Devices, Payment Cards and the Law, Truth in Lending Act and Regulation Z, Card Act, Electronic Fund Transfer Act and Regulation E, Fair Credit Reporting Act, Federal Bank Secrecy Act, State Money Transmitter Laws.

UNIT V ANTI-MONEY LAUNDERING AND CYBERSECURITY 9

Reporting requirements under the Bank Secrecy Act, Patriot Act, Panalties for violating the BSA, Virtual currencies and the Bank Secrecy Act, Cybersecurity Frameworks, Cybersecurity Act of 2015, Contractual and Self Regulatory obligations.

REFERENCES

1. JelenaMadir, FinTech – Law and Regulation, Edward Elgar Publishing Limited, 2019
2. Valerio Lemma, Fintech Regulation : Exploring New Challenges of the Capital Markets Union, Palgrave Macmillan, 2020
3. Chris Brummer, Fintech Law in a Nutshell, West Academic Publishing, 2020
4. Bernardo Nicoletti, The Future of Fintech, Integrating Finance and Technology in Financial Services, Springer Nature, 2017
5. Kevin C. Taylor, FinTech Law : A Guide to Technology Law in the Financial Services Industry, BNA Books, 2014
6. Lee Reiners, FinTech Law and Policy, 2018

OFD351 HOLISTIC NUTRITION L T P C

3 0 0 3

UNIT I NUTRITION AND HEALTH 9

Introduction to the principles of nutrition; Basics of nutrition including; micronutrients (vitamins and minerals), the energy-yielding nutrients (Carbohydrates, Lipids and Proteins), metabolism, digestion, absorption and energy balance. Lipids: their functions, classification, dietary requirements, digestion & absorption, metabolism and links to the major fatal diseases, heart disease and cancer.

U**NIT II AYURVEDA – MIND/BODY HEALING 9**

Philosophy of Holistic Nutrition with spiritual and psychological approaches towards attaining optimal health; Principles and practical applications of Ayurveda, the oldest healing system in the world. Three forces – Vata, Pitta and Kapha, that combine in each being into a distinct constitution. Practical dietary and lifestyle recommendations for different constitutions will also be explored in real case studies.

UNIT III NUTRITION AND ENVIRONMENT 9

Based on an underlying philosophy that environments maintain and promote health and that individuals have a right to self-determination and self-knowledge, Nutrition principles which promote health and prevent disease. Safety of our food supply, naturally occurring and environmental toxins in foods, microbes and food poisoning.

UNIT IV COMPARATIVE DIETS 9

Evaluating principles of food dynamics, nutrient proportions, holistic individuality, the law of opposites, food combining, and more. Therapeutic benefits and limitations of several alternative diet approaches, including: modern diets (intermittent fasting, macrobiotics), food combining (colour-therapy/rainbow diet), high protein diets (Ketogenic, Paleo), Vegetarian approaches (plant-based/vegetarian/vegan variations, fruitarian, raw food), as well as cleansing and detoxification diets (caffeine, alcohol, and nicotine detoxes, juice fasts).

UNIT V PREVENTIVE HEALTH CARE 9

Proper nutrition protection against, reverse and/or retard many ailments including: osteoporosis, diabetes, atherosclerosis and high blood pressure, arthritis, cancer, anemia, kidney disease and colon cancer. Current research developments on phytochemicals, antioxidants and nutraceuticals will be explored.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1 Discuss the role of essential nutrients in physical, mental and emotional wellness
CO2 Discuss the role of deficiencies in essential nutrients in the disease process
CO3 Explain how the standard American diet relates to the disease process
CO4 Identify five contemporary eating "styles" and lists the pros and cons of each
CO5 Discuss the concept of whole foods nutrition and its relationship to wellness

TEXTBOOKS

1. Desai, B. B., Handbook of Nutrition and Diet. Marcel Dekker, New York. 2000
2. Macrae, R., Rolonson Roles and Sadlu, M.J. 1994. Encyclopedia of Food Science & Technology & Nutrition. Vol. XI. Academic Press

REFERENCES

1. Modern Nutrition in Health & Disease by Young & Shils.
2. Food, Nutrition and Diet Therapy – by Krause and Mahan 1996, Publisher- W.B. Saunders, ISBN: 0721658350
3. Nutritive Value of Indian Foods.- by C. Gopalan, B. V. Rama Sastri, S. C. Balasubramanian Published by National Institute of Nutrition, Indian Council of Medical Research, 1989

AI3021 IT IN AGRICULTURAL SYSTEM L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the students to areas of agricultural systems in which IT and computers play a major role.
- To also expose the students to IT applications in precision farming, environmental control systems, agricultural systems management and weather prediction models.

UNIT I PRECISION FARMING 9

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

UNIT II ENVIRONMENT CONTROL SYSTEMS 9

Artificial light systems, management of crop growth in greenhouses, simulation of CO_2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.

UNIT III AGRICULTURAL SYSTEMS MANAGEMENT 9

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

UNIT IV WEATHER PREDICTION MODELS 9

Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.

UNIT V E-GOVERNANCE IN AGRICULTURAL SYSTEMS 9

Expert systems, decision support systems, Agricultural and biological databases, e-commerce, e-

business systems & applications, Technology enhanced learning systems and solutions, e-learning, Rural development and information society.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. National Research Council, “Precision Agriculture in the 21st Century”, National Academies Press, Canada, 1997.
2. H. Krug, Liebig, H.P. “International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation”, 1989.

REFERENCES:

1. Peart, R.M., and Shoup, W. D., “Agricultural Systems Management”, Marcel Dekker, New York, 2004.
2. Hammer, G.L., Nicholls, N., and Mitchell, C., “Applications of Seasonal Climate”, Springer, Germany, 2000.

COURSE OUTCOME:

CO1: The students shall be able to understand the applications of IT in remote sensing applications such as Drones etc.

CO2: The students will be able to get a clear understanding of how a greenhouse can be automated and its advantages.

CO3: The students will be able to apply IT principles and concepts for management of field operations.

CO4: The students will get an understanding about weather models, their inputs and applications.

CO5: The students will get an understanding of how IT can be used for e-governance in agriculture.

CO’s-PO’s & PSO’s MAPPING

PO/PSO		Course Outcome					**Overall correlation of CO s to POs**
		CO1	**CO2**	**CO3**	**CO4**	**CO5**	
PO1	Knowledge of Engineering Sciences	2	3	2	3	2	2
PO2	Problem Analysis	3	3	3	3	3	3
PO3	Design/ Development of Solutions	3	3	3	3	3	3
PO4	Investigations	2	3	2	1	2	2
PO5	Modern Tool Usage	3	3	3	3	3	3
PO6	Individual and Team work	1	1	2	2	3	2
PO7	Communication	3	3	3	3	3	3
PO8	The Engineer and Society	3	3	2	3	3	3
PO9	Ethics	1	1	2	1	2	1
PO10	Environment and Sustainability	3	3	3	3	3	3
PO11	Project Management and Finance	3	3	3	3	3	3
PO12	Life Long Learning	3	3	3	3	3	3
PSO1	To make expertise in	1	1	2	2	3	2

	design and engineering problem solving approach in agriculture with proper knowledge and skill						
PSO2	To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.	1	1	2	2	3	2
PSO3	To inculcate entrepreneurial skills through strong Industry-Institution linkage.	1	1	2	2	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

OEI352 INTRODUCTION TO CONTROL ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the control system components and transfer function model with their graphical representation
- To understand the analysis of system in time domain along with steady state error.
- To introduce frequency response analysis of systems.
- To accord basic knowledge in design of compensators.
- To introduce the state space models.

UNIT – I MATHEMATICAL MODELLING 9

Introduction – transfer function – simple electrical, mechanical, ,pneumatic , hydraulic and thermal systems–analogies

UNIT -II FEEDBACK CONTROL SYSTEMS 9

Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios

UNIT - III TIME DOMAIN ANALYSIS 9

Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT - IV STABILITY ANALYSIS 9

Necessary and sufficient conditions, Routh-Hurwitzcriteria of stability, Rootlocus and Bodetechniques, Concept and construction, frequency response.

UNIT - V STATE SPACE TECHNIQUE 9

State vectors–state space models-Digital Controllers–design aspects.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Explore various controllers presently used in industries.
2. Develop control structures for industrial processes.
3. Implement the controllers for various transfer functions of industrial systems.
4. Using software tools for practical exposures to the controllers used in industries by undergoing training.
5. Realisation of various stability criterion techniques for economical operation of process.

COURSE OUTCOMES:

CO1 To represent and develop systems in different forms using the knowledge gained (L5).

CO2 To analyses the system in time and frequency domain (L4).

CO3 Ability to Derive Transfer function Model of Electrical and Mechanical Systems. (L2)

CO4 Ability to Obtain the transfer Function by the Reduction of Block diagram & Signal flow graph (L3)

CO5 To analyses the stability of physical systems(L4).

CO6 To acquire and analyse knowledge in State variable model for MIMO systems(L1)

TEXT BOOKS:

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers,2017.
2. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014

REFERENCES:

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
2. Richard C. Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education,2009.
3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.
4. RamesC.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and
   Control of Engineers", Narosa Publishing House, 2017.
5. M. Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/112107240
2. https://onlinecourses.nptel.ac.in/noc20_me25/preview
3. https://onlinecourses.nptel.ac.in/noc20_ee90/preview
4. https://www.classcentral.com/course/swayam-automatic-control-9850

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1 L5	3	3	3	3	-	-	-	1	-	1	-	1			
2 L4	3	3	3	2	-	-	-	1	-	1	-	1			

3 L2	2	1	2	1	-	-	-	1	-	1	-	1			
4 L5	3	3	3	3	-	-	-	1	-	1	-	1			
5 L4	3	3	3	2	-	-	-	1	-	1	-	1			
6 L4	3	3	3	2	-	-	-	1	-	1	-	1			
AVg.	2.8	2.6	3	2.1	-	-	-	1	-	1	-	1			

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

OPY351 PHARMACEUTICAL NANOTECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- The goal of this course is to provide an insight into the fundamentals of nanotechnology in biomedical and Pharmaceutical research. It will also guide the students to understand how nanomaterials can be used for a diversity of analytical and medicinal rationales.

UNIT I NANOSTRUCTURES 9

Preparation, properties and characterization - Self-assembling nanostructure - vesicular and micellar polymerization-nanofilms - Metal Nanoparticles- lipid nanoparticles- nanoemulsion - Molecular nanomaterials: dendrimers, etc.,

UNIT II NANOTECHNOLOGY IN BIOMEDICAL INDUSTRY 9

Reconstructive Intervention and Surgery- Nanomaterials in bone substitutes and dentistry – Implants and Prosthesis -in vivo imaging- genetic defects and other disease states — Nanorobotics in Surgery –Nanocarriers: sustained, controlled, targeted drug delivery systems.

UNIT III NANOTECHNOLOGY IN CANCER THERAPY 9

Cancer Cell Targeting and Detection- Polymeric Nanoparticles for cancer treatment – mechanism of drug delivery to tumors -advantages and limitations - Multifunctional Agents - Cancer Imaging – Magnetic Resonance Imaging- Cancer Immunotherapy.

UNIT IV NANOTECHNOLOGY IN COSMETICS 9

Polymers in cosmetics: Film Formers – Thickeners – Hair Colouring – Conditioning Polymers: conditioning, Cleansing – Silicons – Emulsions – Stimuli Responsive Polymeric Systems - Formulation of Nano Gels, Shampoos, Hair-conditioners -Micellar self-assembly Sun-screen dispersions for UV protection – Color cosmetics.

UNIT V NANOTOXICITY 9

NanoToxicology- introduction, dose relationship- Hazard Classification-Risk assessment and management - factors affecting nano toxicity- Dermal Effects of Nanomaterials, Pulmonary, Neuro and Cardiovascular effects of Nanoparticles - Gene–Cellular and molecular Interactions of Nanomaterials.

TOTAL:45 PERIODS

COURSE OUTCOMES:

The student will be able to

CO1: Identify the process for the preparation and characterization of the different nanostructured materials.

CO2: Apply the nanotechnology in biomedical discipline with related to drug delivery and disease diagnosis

CO3: Develop the process, experiments and apply in identifying in a societal and global context.

CO4: Design and develop the process with suitable equipment for the preparation of nanomaterials in developing cosmetic products.

CO5: Understand the ethical principles to confirm the safety of the nano products with respect to risk assessment and its management.

CO6: Have the knowledge about nanotechnology products and its different applications in a societal and global context.

TEXT BOOKS:

1. Springer Handbook of Nanotechnology- Ed. by B. Bhushan, Springer-Verlag 2004
2. Nanobiotechnology: Concepts, Applications and Perspectives,. CM.Niemeyer C A. Mirkin, (Eds) , Wiley, 2004
3. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, Second Edition, CRC Press, 2013
4. Sarah E. Morgan, Kathleen O. Havelka, Robert Y. Lochhead “Cosmetic Nanotechnology: Polymers and Colloids in Cosmetics”, American Chemical Society, 2006.

REFERENCES:

1. Nanotechnology in Biology and Medicine: Methods, Devices and Applications, Tuan VoDinh, CRC Press, 2007
2. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R. Rao, A. Muller, A. K. Cheetham (Eds), Wiley-VCH Verlag 2004
3. Nanotechnology: Environmental Health and safety, Risks, Regulation and Management, Matthew Hull and Diana Bowman, Elsevier, 2010.

CO’s-PO’s & PSO’s MAPPING

Course Outcome Statements	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3							1	2		2	3			2
CO2	3	3			2	2	3							3		
CO3		3	3	3	2	2			1				3		3	
CO4			3	3		2			1						3	
CO5						3		3	2			2	3			3
CO6	3		3			2						2	3		3	2
Overall CO	3	3							1	2		2	3			2

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)

OAE351 **AVIATION MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To acquire solid background of managerial skills in aviation management
- To develop personality to face business difficulties.
- To control multicultural conditions.
- To identify the relevant analytical and logical skills to deal with problems in the airline industry.
- To learn the concepts of performing well in teams, professionalism, and the knowledge acquired in the field of airport planning, airport security, passengers forecasting, aerodromes work etc

UNIT I INTRODUCTION **9**

History of aviation – organisation, global, social & ethical environment – history of Aviation in India – major players in the airline industry - swot analysis of the different Airline companies in India – market potential of airline industry in India – new airport Development plans – current challenges in the airline industry - competition in the Airline industry – domestic and international from an Indian perspective

UNIT II AIRPORT INFRASTRUCTURE AND MANAGEMENT **8**

Airport planning – terminal planning design and operation – airport operations – Airport functions – organisation structure in an airline - airport authority of India - Comparison of global and Indian airport management – role of AAI -airline privatisation - full Privatisation - gradual privatisation – partial privatization

UNIT III AIR TRANSPORT SERVICES **12**

Various airport services - international air transport services – Indian scenario – an Overview of airports in Delhi, Mumbai, Hyderabad and Bangalore – the role of private Operators – airport development fees, rates, tariffs

UNIT IV INSTITUTIONAL FRAMEWORK **8**

Role of DGCA - slot allocation – methodology followed by AFC and DGCA -management of Bilaterals – economic regulations

UNIT V CONTROLLING **8**

Role of air traffic control - airspace and navigational aids – control process – case Studies in airline industry – Mumbai Delhi airport privatisation – Navi Mumbai airport Tendering process – 6 cases in the airline industry

TOTAL : 45 PERIODS

TEXT BOOKS

1. Graham.A. Managing Airports: An International Perspective - Butterworth - Heinemann, Oxford 2001.
2. Wells.A. Airport Planning and Management, 4th Edition McGraw- Hill, London 2000.

REFERENCES

1. Doganis. R. The Airport Business Routledge, London 1992
2. Alexender T. Wells, Seth Young, Principles of Airport Management, McGraw Hill 2003
3. P S Senguttavan Fundementals of Air Transport Management , Excel Books 2007

4. Richard de Neufille, Airport Systems: Planning, Design and Management, McGraw-Hill London 2007.
5.. Manual of Aerodrome licensing of AAI airports – AAI website – freely downloadable – issue may 2010

COURSE OUTCOMES:

CO1: To interpret business difficulties.
CO2: To Dissect multicultural conditions.
CO3: To identify and apply the relevant analytical and logical skills to deal with problems in the airline industry.
CO4: To Develop well in teams, professionalism etc.
CO5: To apply the knowledge acquired in the field of airport planning, airport security, passengers forecasting, aerodromes work etc.

CCS342 DEVOPS L T P C
2 0 2 3

COURSE OBJECTIVES:

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I INTRODUCTION TO DEVOPS 6

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

UNIT II COMPILE AND BUILD USING MAVEN & GRADLE 6

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle

UNIT III CONTINUOUS INTEGRATION USING JENKINS 6

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV CONFIGURATION MANAGEMENT USING ANSIBLE 6

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V BUILDING DEVOPS PIPELINES USING AZURE 6

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file

COURSE OUTCOMES:

CO1: Understand different actions performed through Version control tools like Git.

CO2: Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.

CO3: Ability to Perform Automated Continuous Deployment

CO4: Ability to do configuration management using Ansible

CO5: Understand to leverage Cloud-based DevOps tools using Azure DevOps

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Create Maven Build pipeline in Azure
2. Run regression tests using Maven Build pipeline in Azure
3. Install Jenkins in Cloud
4. Create CI pipeline using Jenkins
5. Create a CD pipeline in Jenkins and deploy in Cloud
6. Create an Ansible playbook for a simple web application infrastructure
7. Build a simple application using Gradle
8. Install Ansible and configure ansible roles and to write playbooks

TOTAL:60 PERIODS

TEXT BOOKS

1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2. Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014

REFERENCES

1. Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020
2. by Mitesh Soni
3. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.
4. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.
5. Mariot Tsitoara, “Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019.
6. https://www.jenkins.io/user-handbook.pdf
7. https://maven.apache.org/guides/getting-started/

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
2	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
3	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
4	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
5	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2

AVg.	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

CCS361 ROBOTIC PROCESS AUTOMATION L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and Maintain the software bot.

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 6

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT II AUTOMATION PROCESS ACTIVITIES 6

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events

UNIT III APP INTEGRATION, RECORDING AND SCRAPING 6

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.

UNIT IV EXCEPTION HANDLING AND CODE MANAGEMENT 6

Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT V DEPLOYMENT AND MAINTENANCE 6

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

Setup and Configure a RPA tool and understand the user interface of the tool:

1. Create a Sequence to obtain user inputs display them using a message box;
2. Create a Flowchart to navigate to a desired page based on a condition;
3. Create a State Machine workflow to compare user input with a random number.
4. Build a process in the RPA platform using UI Automation Activities.
5. Create an automation process using key System Activities, Variables and Arguments
6. Also implement Automation using System Trigger

7. Automate login to (web)Email account
8. Recording mouse and keyboard actions.
9. Scraping data from website and writing to CSV
10. Implement Error Handling in RPA platform
11. Web Scraping
12. Email Query Processing

TOTAL:60 PERIODS

TEXT BOOKS:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2. Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020.

REFERENCES:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
3. A Gerardus Blokdyk, "Robotic Process Automation Rpa A Complete Guide ", 2020

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	3	-	-	-	1	3	3	2	2	2	1
2	1	1	2	3	3	-	-	-	1	2	3	1	3	2	1
3	2	3	2	3	3	-	-	-	2	3	1	1	3	3	3
4	1	2	1	2	2	-	-	-	1	2	1	3	3	3	2
5	3	3	3	3	3	-	-	-	3	1	1	1	3	2	1
AVg.	2	2.2	2	2.4	2.8	-	-	-	1.6	2.2	1.8	1.6	2.8	2.4	1.6

COURSE

OPEN ELCTIVE III

OHS351 ENGLISH FOR COMPETITIVE EXAMINATIONS L T P C

3 0 0 3

Course Description:

Students aspiring to take up competitive exams of which the English language is a vital component will find this course useful. Designed for students in the higher semesters, the course will help students to familiarise themselves with those aspects of English that are tested in these examinations.

COURSE OBJECTIVES:

- To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS).
- To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
- To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.
- To improve students' confidence to express their ideas and opinions in formal contexts
- To create awareness of accuracy and precision in communication

UNIT I **9**

Orientation on different formats of competitive exams - Vocabulary – Verbal ability – Verbal reasoning - Exploring the world of words – Essential words – Meaning and their usage – Synonyms-antonyms – Word substitution – Word analogy – Idioms and phrases – Commonly confused words – Spellings – Word expansion – New words in use.

UNIT II **9**

Grammar – Sentence improvement –Sentence completion – Rearranging phrases into sentences – Error identification –Tenses – Prepositions – Adjectives – Adverbs – Subject-verb agreement – Voice – Reported speech – Articles – Clauses – Speech patterns.

UNIT III **9**

Reading - Specific information and detail – Identifying main and supporting ideas – Speed reading techniques – Improving global reading skills – Linking ideas – Summarising – Understanding argument – Identifying opinion/attitude and making inferences - Critical reading.

UNIT IV **9**

Writing – Pre-writing techniques – Mindmap - Describing pictures and facts - Paragraph structure – organising points – Rhetoric writing – Improving an answer – Drafting, writing and developing an argument – Focus on cohesion – Using cohesive devices –Analytic writing – Structure and types of essay – Mind maps – Structure of drafts, letters, memos, emails – Statements of Purpose – Structure, Content and Style.

UNIT V **9**

Listening and Speaking – Contextual listening – Listening to instructions – Listening for specific information – Identifying detail, main ideas – Following signpost words – Stress, rhythm and intonation - Speaking to respond and elicit ideas – Guided speaking – Opening phrases – Interactive communication – Dysfluency -Sentence stress – Speaking on a topic – Giving opinions – Giving an oral presentation – Telling a story or a personal anecdote – Talking about oneself - Utterance – Speech acts- Brainstorming ideas – Group discussion.

TOTAL: 45 PERIODS

LEARNING OUTCOMES:

At the end of the course, learners will be able

CO1: expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required

CO2: identify errors with precision and write with clarity and coherence

CO3: understand the importance of task fulfilment and the usage of task-appropriate vocabulary
CO4: communicate effectively in group discussions, presentations and interviews
CO5: write topic based essays with precision and accuracy

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	3	3	1	3	3	3	3	1	3	1	3	-	-	-
2	2	3	3	2	3	3	3	3	1	3	3	3	-	-	-
3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
4	2	2	2	2	2	2	2	2	3	3	3	3	-	-	-
5	2	2	2	2	2	2	2	2	2	3	2	3	-	-	-
AVg.	**2**	**2.6**	**2.6**	**2**	**2.6**	**2.6**	**2.6**	**2.6**	**2**	**3**	**2.4**	**3**	**-**	**-**	**-**

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

Teaching Methods:
Instructional methods will involve discussions, taking mock tests on various question papers – Objective, multiple-choice and descriptive. Peer evaluation, self-check on improvement and peer feedback - Practice sessions on speaking assessments, interview and discussion – Using multimedia.

Evaluative Pattern:
Internal Tests – 50%
End Semester Exam - 50%

TEXTBOOKS:
1. R.P.Bhatnagar - *General English for Competitive Examinations.* Macmillan India Limited, 2009.

REFERENCEBOOKS:
1. Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.
2. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010.
3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.

Websites
http://www.examenglish.com/, http://www.ets.org/ , http://www.bankxams.com/
http://civilservicesmentor.com/, http://www.educationobserver.com
http://www.cambridgeenglish.org/in/

OMG352 NGOS AND SUSTAINABLE DEVELOPMENT L T P C
3 0 0 3

COURSE OBJECTIVES
- . to understand the importance of sustainable development

- to acquire a reasonable knowledge on the legal frameworks pertaining to pollution control and environmental management
- to comprehend the role of NGOs in attaining sustainable development

Unit I ENVIRONMENTAL CONCERNS 9

Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes

UNIT II ROLE OF NGOS 9

Role of NGO's in national development, NGO's and participatory management, Challenges and limitations of NGO's, Community Development programmes, Role of NGO's in Community Development programmes, Participation of NGO's in environment management, Corporate Social responsibility, NGO's and corporate social responsibility

UNIT III SUSTAINABLE DEVELOPMENT 9

Issues and Challenges of Sustainable Development, Bioenergy, Sustainable Livelihoods and Rural Poor in Sustainable Development, Protecting ecosystem services for sustainable development, Non-renewable sources of energy and its effect, Renewable sources of energy for sustainability, Nuclear resources and Legal Regulation of Hazardous Substances, Sustainable Development: Programme and Policies, Sustainability assessment and Indicators

UNIT IV NGO'S FOR SUSTAINABILITY 9

Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies

UNIT V LEGAL FRAMEWORKS 9

Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO's in implementing environmental laws, Challenges in the implementation of environmental legislation

TOTAL 45 : PERIODS

COURSE OUTCOMES

Upon completion of this course, the student will :

CO1 Have a thorough grounding on the issues and challenges being faced in attaining sustainable development

CO2 have a knowledge on the role of NGOs towards sustainable developemnt

CO 3 present strategies for NGOs in attaining sustainable development

CO 4 recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment

CO 5 understand the environmental legislations

REFERENCES

1. Kulsange, S and Kamble, R. (2019). Environmental NGO's: Sustainability Stewardship, Lap Lambert Academic Publishing, India, ISBN-13: 978-6200442444.
2. Dodds, F. (2007). NGO diplomacy: The influence of nongovernmental organizations in international environmental negotiations. Mit Press, Cambridge, ISBN-13: 978-0262524766.
3. Ghosh, S. (Ed.). (2019). Indian environmental law: Key concepts and principles. Orient BlackSwan, India, ISBN-13: 978-9352875795.
4. Alan Fowler and Chiku Malunga (2010) NGO Management: The Earthscan Companion, Routledge, ISBN-13 : 978-1849711197.

OMG353 DEMOCRACY AND GOOD GOVERNANCE L T P C

3 0 0 3

UNIT-I (9)

Structure and Process of Governance: Indian Model of Democracy, Parliament, Party Politics and Electoral Behaviour, Federalism, the Supreme Court and Judicial Activism, Units of Local Governance

UNIT-II (9)

Regulatory Institutions – SEBI, TRAI, Competition Commission of India,

UNIT-III (9)

Lobbying Institutions: Chambers of Commerce and Industries, Trade Unions, Farmers Associations, etc.

UNIT- IV (9)

Contemporary Political Economy of Development in India: Policy Debates over Models of Development in India, Recent trends of Liberalisation of Indian Economy in different sectors, E-governance

UNIT-V (9)

Dynamics of Civil Society: New Social Movements, Role of NGO's, Understanding the political significance of Media and Popular Culture.

TOTAL 45 : PERIODS

REFERENCES:

1. Atul Kohli (ed.): The Success of India's Democracy, Cambridge University Press, 2001.
2. Corbridge, Stuart and John Harris: Reinventing India: Liberalisation, Hindu Nationalism and Popular Democracy, Oxford University Press, 2000.
3. J.Dreze and A.Sen, India: Economic Development and Social Opportunity, Clarendon, 1995.
4. Saima Saeed: Screening the Public Sphere: Media and Democracy in India,2013
5. Himat Singh: Green Revolution Reconsidered: The Rural World of Punjab, OUP, 2001.
6. Jagdish Bhagwati: India in Transition: Freeing The Economy, 1993.
7. Smitu Kothari: Social Movements and the Redefinition of Democracy, Boulder, Westview, 1993.

CME365 RENEWABLE ENERGY TECHNOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES

- To know the Indian and global energy scenario
- To learn the various solar energy technologies and its applications.
- To educate the various wind energy technologies.
- To explore the various bio-energy technologies.
- To study the ocean and geothermal technologies.

UNIT – I ENERGY SCENARIO 9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT – II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT – III WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT – IV BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT – V OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Discuss the Indian and global energy scenario.
CO2: Describe the various solar energy technologies and its applications.
CO3: Explain the various wind energy technologies.
CO4: Explore the various bio-energy technologies.
CO5: Discuss the ocean and geothermal technologies.

TEXT BOOKS:

- Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
- Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	2	3	2	2	1	1	3	2	1	2
2	3	2	2	1	1	1	3	1	1	1	2	3	2	1	2
3	3	2	3	1	2	1	3	1	1	1	1	3	1	1	2
4	2	2	2	1	2	1	3	1	1	1	2	3	2	2	2
5	2	1	2	1	2	1	3	1	1	1	1	3	2	1	2
Low (1) ; Medium (2) ; High (3)															

1 - low, 2 - medium, 3 - high, '-' - no correlation

OME354 APPLIED DESIGN THINKING L T P C
3 0 0 3

COURSE OBJECTIVES:

The course aims to

- Introduce tools & techniques of design thinking for innovative product
- development Illustrate customer-centric product innovation using on simple
- use cases Demonstrate development of Minimum usable Prototypes
- Outline principles of solution concepts & their evaluation
- Describe system thinking principles as applied to complex systems

UNIT I DESIGN THINKING PRINCIPLES 9

Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies

UNIT II ENDUSER-CENTRIC INNOVATION 9

Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user,

User persona & user stories. Activity: Customer development process - Customer interviews and field visit

UNIT III APPLIED DESIGN THINKING TOOLS 9

Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design

UNIT IV CONCEPT GENERATION 9

Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts

UNIT V SYSTEM THINKING 9

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, learners will be able to:

CO1: Define & test various hypotheses to mitigate the inherent risks in product innovations.

CO2: Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.

CO3: Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching

CO4: Apply system thinking in a real-world scenario

TEXT BOOKS

1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2. Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value
3. Proposition Design: How to Create Products and Services Customers Want, Wiley
4. Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute.
5. Tim Brown,(2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.

REFERENCES

1. https://www.ideou.com/pages/design-thinking#process
2. https://blog.forgefor ward.in/valuation-risk-versus-validation-risk-in-product-innovations-49f253ca86 24
3. https://blog.forgefor ward.in/product-innovation-rubric-adf5ebdfd356
4. https://blog.forgefor ward.in/evaluating-product-innovations-e8178e58b86e
5. https://blog.forgefor ward.in/user-guide-for-product-innovation-rubric-857181b253dd
6. https://blog.forgefor ward.in/star tup-failure-is-like-true-lie-7812cdfe9b85

MF3003 **REVERSE ENGINEERING** **LT P C**
3 0 0 3

COURSE OBJECTIVES:

- The main learning objective of this course is to prepare students for:
- Applying the fundamental concepts and principles of reverse engineering in product design and development.
- Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Analysing the various legal aspect and applications of reverse engineering in product design and development.
- Understand about 3D scanning hardware & software operations and procedure to generate 3D model

UNIT I INTRODUCTION & GEOMETRIC FORM 9 Hours

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION 9 Hours

.Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

UNIT III DATA PROCESSING 9 Hours

Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.

UNIT IV 3D SCANNING AND MODELLING 9 Hours

Introduction, working principle and operations of 3D scanners: Laser, White Light, Blue Light - Applications- Software for scanning and modelling: Types- Applications- Preparation techniques for Scanning objects- Scanning and Measuring strategies - Calibration of 3D Scanner- Step by step procedure: 3D scanning - Geometric modelling – 3D inspection- Case studies.

UNIT V INDUSTRIAL APPLICATIONS 9 Hours

Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry. Case studies and Solving Industrial projects in Reverse Engineering.Legality: Patent – Copyrights –Trade Secret – Third-Party Materials.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the fundamental concepts and principles of reverse engineering in product design and development.

CO2: Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.

CO3: Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
CO4: Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
CO5: Analyze the various legal aspect
CO6: Applications of reverse engineering in product design and development.

TEXT BOOKS:
1. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, 1st Edition, McGraw-Hill Education, 2014
2. Wego Wang, Reverse Engineering Technology of Reinvention, CRC Press, 2011

REFERENCES:
1. Scott J. Lawrence , Principles of Reverse Engineering, Kindle Edition, 2022
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001
3. Kathryn, A. Ingle, “Reverse Engineering”, McGraw-Hill, 1994.
4. Linda Wills, “Reverse Engineering”, Kluver Academic Publishers, 1996
5. Vinesh Raj and Kiran Fernandes, “Reverse Engineering: An Industrial Perspective”, Springer-Verlag London Limited 2008.

OPR351 SUSTAINABLE MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:
- To be acquainted with sustainability in manufacturing and its evaluation.
- To provide knowledge in environment and social sustainability.
- To provide the student with the knowledge of strategy to achieve sustainability.
- To familiarize with trends in sustainable operations.
- To create awareness in current sustainable practices in manufacturing industry.

UNIT – I ECONOMIC SUSTAINABILITY 9
Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status - Emerging issues- Innovative products- Reconfiguration manufacturing enterprises - Competitive manufacturing strategies - Performance evaluation- Management for sustainability - Assessments of economic sustainability

UNIT – II SOCIAL AND ENVIRONMENTAL SUSTAINABILITY 9
Social sustainability – Introduction-Work management -Human rights - Societal commitment - Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources -Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability

UNIT – III SUSTAINABILITY PRACTICES 9
Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of

sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements – Cost and time model.

UNIT – IV MANUFACTURING STRATEGY FOR SUSTAINABILITY 9

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT – V TRENDS IN SUSTAINABLE OPERATIONS 9

Principles of sustainable operations - Life cycle assessment manufacturing and service activities - influence of product design on operations - Process analysis – Capacity management - Quality management -Inventory management - Just-In-Time systems - Resource efficient design - Consumerism and sustainable well-being.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Discuss the importance of economic sustainability.

CO2: Describe the importance of sustainable practices.

CO3: Identify drivers and barriers for the given conditions.

CO4: Formulate strategy in sustainable manufacturing.

CO5: Plan for sustainable operation of industry with environmental, cost consciousness.

TEXT BOOKS:

1. Ibrahim Garbie, “Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0”, Springer International Publishing., United States, 2016, ISBN-13: 978-3319293042.
2. Davim J.P., “Sustainable Manufacturing”, John Wiley & Sons., United States, 2010,ISBN: 978-1-848-21212-1.

REFERENCES:

1. Jovane F, Ęmper, W.E. and Williams, D.J., “The ManuFuture Road: Towards Competitive and Sustainable High-Adding-Value Manufacturing”, Springer,2009, United States, ISBN 978-3-540-77011-4.
2. Kutz M., “Environmentally Conscious Mechanical Design”, John Wiley & Sons., United States, 2007, ISBN: 978-0-471-72636-4.
3. Seliger G., “Sustainable Manufacturing: Shaping Global Value Creation”, Springer, United States, 2012, ISBN 978-3-642-27289-9.

CO’s-PO’s & PSO’s MAPPING															
COs/Pos &PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	2	-	-	-	2	2	-	1	1	2	2	2	1
CO2	3	-	-	-	-	-	2	-	-	1	1	2	1	2	2
CO3	3	-	-	-	-	-	2	3	-	1	1	2	1	2	2
CO4	3	-	3	-	-	-	2		-	1	1	2	2	2	1

CO5	3	-	3	-	-	-	2	2	-	1	1	2	2	2	1
CO/PO & PSO Average	3	-	3	-	-	-	2	2	-	1	1	2	2	2	1
1 - low, 2 - medium, 3 - high, '-' - no correlation															

AU3791 ELECTRIC AND HYBRID VEHICLES L T P C
3 0 0 3

COURSE OBJECTIVES:

The objective of this course is to prepare the students to know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modelling, sizing, and sub system design and hybrid vehicle control.

UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems.

UNIT II ENERGY SOURCES 9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.

UNIT III MOTORS AND DRIVES 9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT IV POWER CONVERTERS AND CONTROLLERS 9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

UNIT V HYBRID AND ELECTRIC VEHICLES 9

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the student will be able to

CO1: Understand the operation and architecture of electric and hybrid vehicles
CO2: Identify various energy source options like battery and fuel cell
CO3: Select suitable electric motor for applications in hybrid and electric vehicles.
CO4: Explain the role of power electronics in hybrid and electric vehicles
CO5: Analyze the energy and design requirement for hybrid and electric vehicles.

TEXT BOOKS:

1. Iqbal Husain, " Electric and Hybrid Vehicles-Design Fundamentals", CRC Press,2003
2. Mehrdad Ehsani, " Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRCPress,2005.

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained " John Wiley & Sons,2003
2. Lino Guzzella, " Vehicle Propulsion System" Springer Publications,2005
3. Ron HodKinson, "Light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication,2005.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	2	1		3	2					2		1	3
2	1	1	2	1		3	2					2		1	3
3	1	1	2	1		3	2					2		1	3
4	1	1	2	1		3	2					2		1	3
5	1	1	2	1		3	2					2		1	3
Avg.	1	1	2	1		3	2					2		1	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

OAS352 SPACE ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- Use the standard atmosphere tables and equations.
- Find lift and drag coefficient data from NACA plots.
- Apply the concept of static stability to flight vehicles.
- Describe the concepts of stress, strain, Young's modulus, Poisson's ratio, yield strength.
- Demonstrate a basic knowledge of dynamics relevant to orbital mechanics.

UNIT I STANDARD ATMOSPHERE 6

History of aviation – standard atmosphere - pressure, temperature and density altitude.

UNIT II AERODYNAMICS 10

Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.

UNIT III PERFORMANCE AND PROPULSION 9

Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -thrust/power available and thrust/power required.

UNIT IV AIRCRAFT STABILITY AND STRUCTURAL THEORY 10

Degrees of freedom of aircraft motions - stable, unstable and neutral stability - concept of static stability - Hooke's Law- brittle and ductile materials - moment of inertia - section

modulus.

UNIT V SPACE APPLICATIONS 10

History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler's laws of orbits - Newtons law of gravitation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Illustrate the history of aviation & developments over the years
CO2: Ability to identify the types & classifications of components and control systems
CO3: Explain the basic concepts of flight & Physical properties of Atmosphere
CO4: Identify the types of fuselage and constructions.
CO5: Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS:

1. John D. Anderson, Introduction to Flight, 8 th Ed., McGraw-Hill Education, New York,2015.
2. E Rathakrishnan, "Introduction to Aerospace Engineering: Basic Principles of Flight", John Wiley, NJ, 2021.
3. Stephen. A. Brandt, " Introduction to Aeronautics: A design perspective " American Institute of Aeronautics & Astronautics,1997.

REFERENCE:

1. Kermode, A.C., "Mechanics of Flight", Himalayan Book, 1997.

OIM351 INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce fundamental concepts of industrial management
- To understand the approaches to the study of Management
- To learn about Decision Making, Organizing and leadership
- To analyze the Managerial Role and functions
- To know about the Supply Chain Management'

UNIT I INTRODUCTION 9

Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of Directors - Committees - Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union

UNITII FUNCTIONS OF MANAGEMENT 9

Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization -Organizational culture, Staffing - selection and training .Placement - Performance appraisal - Career Strategy – Organizational Development. Leading - Managing human factor - Leadership .Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety.

UNIT III ORGANIZATIONAL BEHAVIOUR 9

Definition - Organization - Managerial Role and functions -Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension – Need Theories - Process Theories - Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and approaches.

UNIT IV GROUPDYNAMICS 9

Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types -Causes - Conflict Resolution -Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development -Change Process – Resistance to Change - Culture and Ethics.

UNIT V MODERN CONCEPTS 9

Management by Objectives (MBO) - Management by Exception (MBE),Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re-engineering(BPR) –Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the basic concepts of industrial management
CO2: Identify the group conflicts and its causes.
CO3: Perform swot analysis
CO4 : Analyze the learning curves
CO5 : Understand the placement and performance appraisal

REFERENCES:

Maynard H.B, “Industrial Engineering Hand book”, McGraw-Hill, sixth 2008

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1											2	1	
2		3	2	3											2
3	2	3	2	3									1	2	3
4	2	2	3	3										3	3
5	2	2											2		
AVg.	2	2.2	2.3	3									1.8	2	2.6

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

OIE354 **QUALITY ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Developing thespecialcontrolproceduresforserviceandprocessorientedindustries.
- Analyzing and understanding the process capability study.
- Developing the acceptance sampling procedures for incoming raw material.

UNIT I INTRODUCTION **9**

Quality Dimensions–Quality definitions–Inspection-Quality control–Quality Assurance–Quality planning-Quality costs–Economics of quality– Quality loss function

UNIT II CONTROLCHARTS **9**

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- $\bar{X}$, R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III SPECIAL CONTROL PROCEDURES **9**

Warning and modified control limits, control chart for individual measurements, multi-vari chart, *X*chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV STATISTICALPROCESSCONTROL **9**

Process stability, process capability analysis using a Histogram or probability plots and control chart.Gauge capability studies,setting specification limits.

UNITV ACCEPTANCESAMPLING **9**

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables,MIL-STD-105DandMIL-STD-414E&IS2500 standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to:

CO1: Control the quality of processes using control charts for variables in manufacturing industries.
CO2: Control the occurrence of defective product and the defects in manufacturing companies.
CO3: Control the occurrence of defects in services.
CO4: Analyzing and understanding the process capability study.
CO5: Developing the acceptance sampling procedures for incoming raw material.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	3		3			1	2			2	1		
2		3	3		3	3			3			3		2	
3	3	3	3		3				3			3	1		
4	3		2		3						1		1		

5		2			3				3			3			1
AVg.	2.6	2.7	2.7		3	3		1	2.7		1	2.7	1	2	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

OSF351 FIRE SAFETY ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES

- To enable the students to acquire knowledge of Fire and Safety Studies
- To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance
- To learn about fire area, fire stopped areas and different types of fire-resistant doors
- To learn about the method of fire protection of structural members and their repair due to fire damage.
- To develop safety professionals for both technical and management through systematic and quality-based study programmes

UNIT I INHERENT SAFETY CONCEPTS 9

Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire- plastics, glass, textile fibres and other house hold materials.

UNIT II PLANT LOCATIONS 9

Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements-standard heating condition, Indian standard test method, performance criteria.

UNIT III WORKING CONDITIONS 9

Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors;

UNIT IV FIRE SEVERITY AND REPAIR TECHNIQUES 9

Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures- Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

UNIT V WORKING AT HEIGHTS 9

Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs - Work Permit Systems-Accident Case Studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES

On completion of the course the student will be able to

CO1:Understand the effect of fire on materials used for construction

CO2:Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.

CO3:To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.

CO4:To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.

CO5:Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS

- Roytman, M. Y,"Principles of fire safety standards for building construction". Amerind Publishing Co. Pvt. Ltd., New Delhi,1975
- John A. Purkiss,"Fire safety engineering design of structures" (2nd edn.), Butterworth Heinemann, Oxford, UK,2009.

REFERENCES:

3. Smith, E.E. and Harmathy, T.Z. (Editors),"Design of buildings for fire safety". ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A,1979.
4. Butcher, E. G. and Parnell, A. C, "Designing of fire safety". JohnWiley and Sons Ltd., New York, U.S.A.1983.
5. Jain, V.K,"Fire safety in buildings" (2nd edn.). New Age International(P) Ltd., New Delhi,2010. 4. Hazop&Hazan,"Identifying and Assessing Process Industry Hazards", Fourth Edition ,1999
6. Frank R. Spellman, Nancy E. Whiting,"The Handbook of Safety Engineering: Principles and Applications", 2009

CO's- PO's & PSO's MAPPING

	PO's												PSO's		
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	-	1	-	-	1	-	-	-	-	-	-	-	-	-
2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
3	1	-	2	-	-	-	3	-	-	1	-	-	-	-	-
4	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
5	2	-	1	-	-	1	1	1	-	1	-	1	-	-	-
AVg.	1.3	-	1.75	-	-	1	1.3	1		1	-	1	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING L T P C

3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the basic importance of NDT in quality assurance.
- Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.

- Equipping themselves to locate a flaw in various materials, products.
- Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards.
- Acquiring the knowledge on the selection of the suitable NDT technique for a given application

UNIT I INTRODUCTION TO NDT & VISUAL TESTING 9

Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

UNIT II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING 9

Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation.

Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications.

UNIT III EDDY CURRENT TESTING & THERMOGRAPHY 9

Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation.

Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.

UNIT IV ULTRASONIC TESTING & AET 9

Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration.

Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications.

UNIT V RADIOGRAPHY TESTING 9

Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Realize the importance of NDT in various engineering fields.

CO2: Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.

CO3: Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.
CO4: Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.
CO5: Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.

TEXT BOOKS:

1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002.
2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition, 2011.
3. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.

REFERENCES:

1. ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.
2. Barry Hull and Vernon John,"Nondestructive Testing", Macmillan, 1989.
3. Chuck Hellier, “Handbook of Nondestructive Evaluation”, Mc Graw Hill, 2012.
4. Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.

CO’s-PO’s & PSO’s MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
C01	2	2	2	3			2	2				2	1	2	
C02	3	1	2	2			2	2				2	2	2	1
C03	3	2	1	2			2	2				2	2	2	
CO4	3	1	2	2			2	2				2	2	2	2
CO5	3	2	2	2			2	2				2	2	2	1
Avg	2.8	1.6	1.8	2.2			2	2				2	1.8	2	1.3

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

OMR351	**MECHATRONICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Selecting sensors to develop mechatronics systems.
- Explaining the architecture and timing diagram of microprocessor, and also interpret and develop programs.
- Designing appropriate interfacing circuits to connect I/O devices with microprocessor.
- Applying PLC as a controller in mechatronics system.
- Designing and develop the apt mechatronics system for an application.

UNIT – I INTRODUCTION AND SENSORS 9

Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic

Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors.

UNIT – II 8085 MICROPROCESSOR 9

Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.

UNIT – III PROGRAMMABLE PERIPHERAL INTERFACE 9

Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.

UNIT – IV PROGRAMMABLE LOGIC CONTROLLER 9

Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.

UNIT – V ACTUATORS AND MECHATRONICS SYSTEM DESIGN 9

Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Select sensors to develop mechatronics systems.

CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.

CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.

CO 4: Apply PLC as a controller in mechatronics system.

CO 5: Design and develop the apt mechatronics system for an application.

CO's-PO's & PSO's MAPPING															
COs/POs & PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	3		2						2	3	2	3
CO2	3	2	1	3		2						2	3	2	3
CO3	3	2	1	3		2						2	3	2	3
CO4	3	2	1	3		2						2	3	2	3
CO5	3	2	1	3		2						2	3	2	3
CO/PO & PSO Average	3	2	1	3		2						2	3	2	3
1 - low, 2 - medium, 3 - high, '-' - no correlation															

TEXT BOOKS

1. Bolton W., "Mechatronics", Pearson Education, 6th Edition, 2015.
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2013.

REFERENCES

1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., “Mechatronics”, Chapman and Hall, 1993.
2. Davis G. Alciatore and Michael B. Histand, “Introduction to Mechatronics and Measurement systems”, McGraw Hill Education, 2011.
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, Cengage Learning, 2010.
4. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and Applications”, McGraw Hill Education, 2015.
5. Smaili. A and Mrad. F, “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007.

ORA351	FOUNDATION OF ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the kinematics, drive systems and programming of robots.
- To study the basics of robot laws and transmission systems.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
- To familiarize students with the various Programming and Machine Vision application in robots.
- To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT – I FUNDAMENTALS OF ROBOT **9**

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.

UNIT – II ROBOT KINEMATICS **9**

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

UNIT – III ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper

UNIT – IV SENSORS IN ROBOTICS **9**

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other

algorithms, applications – Inspection, identification, visual serving and navigation.

UNIT – V PROGRAMMING AND APPLICATIONS OF ROBOT 9

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, students will be able to:

CO1: Interpret the features of robots and technology involved in the control.

CO2: Apply the basic engineering knowledge and laws for the design of robotics.

CO3: Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.

CO4: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.

CO5: Demonstrate the image processing and image analysis techniques by machine vision system.

CO's-PO's & PSO's MAPPING															
COs/POs& PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	1								1			3
CO2	3	2	1	1								1			3
CO3	3	2	1	1								1			3
CO4	3	2	1	1								1			3
CO5	3	2	1	1								1			3
CO/PO & PSO Average															
1 - low, 2 - medium, 3 - high, '-' - no correlation															

TEXT BOOKS:

1. Ganesh.S.Hedge,"A textbook of Industrial Robotics", Lakshmi Publications, 2006.

2. Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications" McGraw Hill 2ND edition 2012.

REFERENCES:

1. Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co. 2007.

2. YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.

3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.

4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.

5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.

OAE352 FUNDAMENTALS OF AERONAUTICAL ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To acquire the knowledge on the Historical evaluation of Airplanes
- To learn the different component systems and functions
- To know the concepts of basic properties and principles behind the flight
- To learn the basics of different structures & construction
- To learn the various types of power plants used in aircrafts

UNIT I HISTORY OF FLIGHT 8

Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II AIRCRAFT CONFIGURATIONS AND ITS CONTROLS 10

Different types of flight vehicles, classifications-Components of an airplane and their functions-Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III BASICS OF AERODYNAMICS 9

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

UNIT IV BASICS OF AIRCRAFT STRUCTURES 9

General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke's law- stress-strain diagrams-elastic constants-Factor of Safety.

UNIT V BASICS OF PROPULSION 9

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production- Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Illustrate the history of aircraft & developments over the years
CO2: Ability to identify the types & classifications of components and control systems
CO3: Explain the basic concepts of flight & Physical properties of Atmosphere
CO4: Identify the types of fuselage and constructions.
CO5: Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS

1. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015
2. . E Rathakrishnan, "Introduction to Aerospace Engineering: Basic Principles of Flight", John Wiley, NJ, 2021
3. Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

REFERENCE

1. SADHU SINGH, “INTERNAL COMBUSTION ENGINES AND GAS TURBINE”-, SS Kataraia & sons, 2015
2. KERMODE , “FLIGHT WITHOUT FORMULAE”, -, Pitman; 4th Revised edition 1989

OGI351	REMOTE SENSING CONCEPTS	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck‘s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff‘s law – Radiation sources: active & passive - Radiation Quantities

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

UNIT III ORBITS AND PLATFORMS 9

Motions of planets and satellites – Newton‘s law of gravitation - Gravitational field and potential - Escape velocity - Kepler‘s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.

UNIT IV SENSING TECHNIQUES 9

Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites

UNIT V DATA PRODUCTS AND INTERPRETATION 9

Photographic and digital products – Types, levels and open source satellite data products –- selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to

CO 1 Understand the concepts and laws related to remote sensing

CO 2 Understand the interaction of electromagnetic radiation with atmosphere and earth material

CO 3 Acquire knowledge about satellite orbits and different types of satellites

CO 4 Understand the different types of remote sensors

CO 5 Gain knowledge about the concepts of interpretation of satellite imagery

TEXTBOOKS:

1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third Edition Universities Press (India) Private limited, Hyderabad, 2018

REFERENCES:

1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.1, AmericanSociety of Photogrametry, Virginia, USA, 2002.
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995
3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988.
4. Introduction to Physics and Techniques of Remote Sensing , Charles Elachi and JacobVan Zyl, 2006 Edition II, Wiley Publication.
5. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011

CO's-PO's & PSO's MAPPING

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis				3	3	3
PO3	Design/Development of Solutions				3	3	3
PO4	Conduct Investigations of Complex Problems				3	3	3
PO5	Modern Tool Usage				3	3	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning	3		3	3	3	3
PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

OAI351 **URBAN AGRICULTURE** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the students the principles of agricultural crop production and the production practices of crops in modern ways.
- To delineate the role of agricultural engineers in relation to various crop production practices.

UNIT I INTRODUCTION 9

Benefits of urban agriculture- economic benefits, environmental benefits, social and cultural benefits, educational, skill-building and job training benefits, health, nutrition and food accessibility benefits.

UNIT II VERTICAL FARMING 9

Vertical farming- types, green facade, living/green wall-modular green wall **,** vegetated mat wall**-** Structures and components for green wall system: plant selection, growing media, irrigation and plant nutrition: Design, light, benefits of vertical gardening. Roof garden and its types. Kitchen garden, hanging baskets: The house plants/ indoor plants

UNIT III SOIL LESS CULTIVATION 9

Hydroponics, aeroponics, aquaponics: merits and limitations, costs and Challenges, backyard gardens- tactical gardens- street landscaping- forest gardening, greenhouses, urban beekeeping

UNIT IV MODERN CONCEPTS 9

Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops

UNIT V WASTE MANAGEMENT 9

Concept, scope and maintenance of waste management- **r**ecycle of organic waste, garden wastes-solid waste management-scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Demonstrate the principles behind crop production and various parameters that influences the crop growth on roof tops
CO2: Explain different methods of crop production on roof tops
CO3: Explain nutrient and pest management for crop production on roof tops
CO4: Illustrate crop water requirement and irrigation water management on roof tops
CO5: Explain the concept of waste management on roof tops

TEXT BOOKS:

1. Martellozzo F and J S Landry. 2020. Urban Agriculture. Scitus Academics Llc.
2. Rob Roggema. 2016. Sustainable Urban Agriculture and Food Planning. Routledge Taylor and Francis Group.
3. Akrong M O. 2012. Urban Agriculture. LAP Lambert Academic Publishing.

REFERENCES:

1. Agha Rokh A. 2008. Evaluation of ornamental flowers and fishes breeding in Bushehr urban wastewater using a pilot-scale aquaponic system. Water and Wastewater, 19 (65): 47–53.
2. Agrawal M, Singh B, Rajput M, Marshall F and Bell J. N. B. 2003. Effect of air pollution on peri-urban agriculture: A case study. Environmental Pollution, 126 (3): 323–329. https://www.sciencedirect.com/science/article/pii/S0269749103002458#aep-section-id24.
3. Jac Smit and Joe Nasr. 1992. Urban agriculture for sustainable cities: using wastes and idle land and water bodies as resources. Environment and Urbanization, 4 (2):141-152.

CO's-PO's & PSO's MAPPING

PO/PSO		CO1	CO2	CO3	CO4	CO5	Overall correlation of COs with POs
PO1	Engineering Knowledge	1	2	1	1	2	1
PO2	Problem Analysis	1	1	1	1	1	2
PO3	Design/ Development of Solutions	1	2	1	1	3	2
PO4	Conduct Investigations of Complex Problems	1	1	2	2	1	1
PO5	Modern Tool Usage	1	2	1	1	1	2
PO6	The Engineer and Society	1	2	1	2	1	1
PO7	Environment and sustainability	1	2	1	1	2	1
PO8	Ethics	2	1	1	1	2	1
PO9	Individual and team work:	1	1	2	1	1	1
PO10	Communication	1	2	1	1	2	1
PO11	Project management and finance	1	1	1	1	1	2
PO12	Life-long learning:	1	2	1	1	3	2
PSO1	To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill	1	2	1	1	2	1
PSO2	To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.	2	1	2	1	1	1
PSO3	To inculcate entrepreneurial skills through strong Industry-Institution linkage.	1	2	1	2	1	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

OEN351 DRINKING WATER SUPPLY AND TREATMENT L T P C
3 0 0 3

COURSE OBJECTIVE:

- To equip the students with the principles and design of water treatment units and distribution system.

UNIT I SOURCES OF WATER 9

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.

UNIT II CONVEYANCE FROM THE SOURCE 9

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

UNIT III WATER TREATMENT 9

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation –- sand filters - Disinfection -– Construction, Operation and Maintenance aspects.

UNIT IV ADVANCED WATER TREATMENT 9

Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems - Iron and Manganese removal - Defluoridation - Construction and Operation and Maintenance aspects

UNIT V WATER DISTRIBUTION AND SUPPLY 9

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs - Functions – Network design – Economics - Computer applications – Appurtenances – Leak detection - Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: an understanding of water quality criteria and standards, and their relation to public health

CO2: the ability to design the water conveyance system

CO3: the knowledge in various unit operations and processes in water treatment

CO4: an ability to understand the various systems for advanced water treatment

CO5: an insight into the structure of drinking water distribution system

TEXTBOOKS :

1. Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.
2. Punmia B.C, Arun K.Jain, Ashok K.Jain, " Water supply Engineering" Lakshmi publication private limited, New Delhi, 2016.
3. Rangwala "Water Supply and Sanitary Engineering", February 2022
4. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.

REFERENCES :

1. Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons, 1954.
2. Babbit.H.E, and Donald.J.J, "Water Supply Engineering" , McGraw Hill book Co, 1984.
3. Steel. E.W.et al., "Water Supply Engineering" , Mc Graw Hill International book Co, 1984.
4. Duggal. K.N., "Elememts of public Health Engineering", S.Chand and Company Ltd,

New Delhi, 1998.

CO's- PO's & PSO's MAPPING

	PO's												PSO's		
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1		3						3		3			3		
2		3		2		2				3			3		
3				2		2				3			3		
4			3	2				3	2	3			3		
5			3	2			1		2	3		1			
Avg.		3	3	2		2	1	3	2	3		1	3		

1.low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

OEE352 ELECTRIC VEHICLE TECHNOLOGY L T P C

3 0 0 3

COURSE OBJECTIVES

- To provide knowledge about electric machines and special machine
- To understand the basics of power converters
- To know the concepts of controlling DC and AC drive systems
- To understand the architecture and power train components.
- To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs)

UNIT I ROTATING POWER CONVERTERS 9

Magnetic circuits- DC machine and AC machine –Working principle of Generator and Motor-DC and AC - Voltage and torque equations – Characteristics and applications. Working principle of special machines like: Brushless DC motor, Switched reluctance motor and PMSM.

UNIT II STATIC POWER CONVERTERS 9

Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and Three phase), DC choppers, single and three phase inverters, Multilevel inverters and Matrix Converters.

UNIT III CONTROL OF DC AND AC MOTOR DRIVES 9

Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, Transformation theory, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives

UNIT IV HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS 9

History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT V MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES **9**

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Able to understand the principles of conventional and special electrical machines.
CO2: Acquired the concepts of power devices and power converters
CO3: Able to understand the control for DC and AC drive systems.
CO4: Learned the electric vehicle architecture and power train components.
CO5: Acquired the knowledge of mechanics of electric vehicles and control of electric vehicles.

CO's-PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2			3								3	3	3
CO2	3	2	2			3			3				3	3	3
CO3	3			3		2	2						3	3	3
CO4	3	2	2		3								3	3	3
CO5	3		2								2		3	3	3
Avg	3	2	2	3	3	1	2		3		2		3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

REFERENCES:

1 Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition, 2020.
2 Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011
3 Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013.
4 Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10th Impression 2021.
5 Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2021.
6 Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, WILEY, 2017
7 James Larminie and John Lowry, 'Electric Vehicle Technology Explained', Second Edition, Wiley, 2012

OEI353 INTRODUCTION TO PLC PROGRAMMING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Understand basic PLC terminologies digital principles, PLC architecture and operation.
- Familiarize different programming language of PLC.

- Develop PLC logic for simple applications using ladder logic.
- Understand the hardware and software behind PLC and SCADA.
- Exposures about communication architecture of PLC/SCADA.

UNIT I INTRODUCTION TO PLC 9

Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O, PLC Types.

UNIT II PLC INSTRUCTIONS 9

PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays-Interlock examples- Timers, Counters, Examples.

UNIT III PLC PROGRAMMING 9

Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions

UNIT IV COMMUNICATION OF PLC AND SCADA 9

Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures

UNIT V CASE STUDIES 9

Stepper Motor Control- Elevator Control-CNC Machine Control- conveyor control-Interlocking Problems

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)
4. Market survey of Communication Network Used for PLC/SCADA.

COURSE OUTCOMES:

CO1 Know the basic requirement of a PLC input/output devices and architecture. (L1)

CO2 Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming.(L2)

CO3 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function BIock.(L3)

CO4 Able to develop a PLC logic for a specific application on real world problem. (L5)

CO5 Ability to Understand the Concepts of Communication used for PLC/SCADA.(L1)

TEXT BOOKS:

1. Frank Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill Edition

2. John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication

REFERENCES:

1. MadhuchanndMitra and SamerjitSengupta, Programmable Logic Controllers Industrial Automation an Introduction, Penram International Publishing Pvt. Ltd.
2. J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles andApplications, Pearson publication

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/108105063
2. https://www.electrical4u.com/industrial-automation/
3. **https://www.etf.ues.rs.ba/~slubura/Procesni%20racunari/Programmable%20Logic%20Controllers%20Programming%20Methods.pdf**
4. https://www.electrical4u.com/industrial-automation/

CO's-PO's & PSO's MAPPING

PO, PSO / CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1					1		1					
CO2	3	3	2					1		1	2				2
CO3	3	3	3	3	1			1		1					
CO4	3	3		3	3			1		1			3	3	
CO5	3	3	3	2	1			1		1			3	3	3
Avg	3	2.9	2.25	2.6	1.6			1		1			3	3	2.9

1 - low, 2 - medium, 3 - high, '-' - no correlation

OCH351 NANO TECHNOLOGY L T P C
3 0 0 3

UNIT I INTRODUCTION 8

General definition and size effects–important nano structured materials and nano particles-importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis.

UNIT II SYNTHESIS OF NANOMATERIALS 8

Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III NANO COMPOSITES 10

Definition- importance of nanocomposites- nano composite materials-classification of composites-metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based-

influence of size, shape and role of interface in composites applications.

UNIT IV NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES 10

Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice-clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V APPLICATIONS OF NANO MATERIALS 9

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots-Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1 - understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.

CO2 – able to acquire knowledge about the different types of nano material synthesis

CO3 – describes about the shape, size,structure of composite nano materials and their interference

CO4 – understand the different characterization techniques for nanomaterials

CO5 - develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS

1. Mick Wilson, Kamali Kannangara,Geoff Smith, Michelle Simmom, Burkhard Raguse, " Nano Technology: Basic Science & Engineering Technology", 2005, Overseas Press

2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" Imperial College Press, 2004

3.William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group 2012.

REFERENCES

1. R.H.J.Hannink & A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd.,Cambridge, 2006.
2. C.N.R.Rao, A.Muller, A.K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl & Co
3. Ivor Brodie and Julius J.Muray,'The physics of Micro/Nano – Fabrication',Springer International Edition,2010

CO's-PO's & PSO's MAPPING

Course Outcomes	Statement	Program Outcome														
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	understand the basic properties such as structural, physical, chemical properties of	2	3	2	3	3	-	-	-	1	1	-	3	1	1	3

	nanomaterials and their applications															
CO2	acquire knowledge about the different types of nano material synthesis	**2**	**3**	**1**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**3**	**2**	**1**	**3**
CO3	describes about the shape, size,structure of composite nano materials and their interference	**2**	**2**	**2**	**3**	**3**	**1**	**1**	**-**	**1**	**1**	**-**	**3**	**2**	**1**	**3**
CO4	understand the different characterization techniques for nanomaterials	**2**	**2**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**-**	**1**	**3**	**1**	**1**	**3**
CO5	develop a deeper knowledge in the application of nanomaterials in different fields	**2**	**2**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**-**	**1**	**3**	**2**	**1**	**3**
	Overall CO	3	**2**	**2**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

OCH352 **FUNCTIONAL MATERIALS** **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I INTRODUCTION **9**

Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact.

UNIT II MOLECULAR SELF ASSEMBLY **9**

Molecular Organization, Self-Assembly in Biology, Energetics of Self-Organization, A Few Case Studies, Synthetic Protocols and Challenges, Solvent-assisted Self-Assembly, Directed Assembly-Langmuir-Blodgett and Langmuir-Schaefer techniques, Technological Applications of SAMs.

UNIT III BIO-INSPIRED MATERIALS **9**

Bio-inspired materials, Classification, Biomimicry, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, 'Bionics'-Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization-En route to Nanotechnology.

UNIT IV SMART OR INTELLIGENT MATERIALS 9

Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composities.

UNIT V MATERIALS FOR POLYMER ELECTRONICS 9

Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.

TEXT BOOK:

1. Vijayamohanan K. Pillai and MeeraParthasarathy, “Functional Materials: A chemist’s perpective”, Universities Press Hyderabad (2012).

REFERENCE:

1. Stephen Manne “Biomimetic Materials Chemistry” Wiley-VCH Newyork, 1966.

OFD352 TRADITIONAL INDIAN FOODS L T P C

3 0 0 3

COURSE OBJECTIVE:

- To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.

UNIT I HISTORICAL AND CULTURAL PERSPECTIVES 9

Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING 9

Traditional methods of milling grains – rice, wheat and corn – equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sundrying, osmotic drying, brining, pickling and smoking.

UNIT III TRADITIONAL FOOD PATTERNS 9

Typical breakfast, meal and snack foods of different regions of India.Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods,pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods

UNIT IV COMMERCIAL PRODUCTION OF TRADITIONAL FOODS 9

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

UNIT V HEALTH ASPECTS OF TRADIONAL FOODS 9

Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1To understand the historical and traditional perspective of foods and food habits
CO2 To understand the wide diversity and common features of traditional Indian foods and meal patterns.

TEXT BOOKS:

1. Sen, Colleen Taylor “Food Culture in India” Greenwood Press, 2005.
2. Davidar, Ruth N. “Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.

OFD353 INTRODUCTION TO FOOD PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVE:

- The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE 9

Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

UNIT II METHODS OF FOOD HANDLING AND STORAGE 9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

UNIT III LARGE-SCALE FOOD PROCESSING 12

Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

UNIT IV FOOD WASTES IN VARIOUS PROCESSES 6

Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.

UNIT V FOOD HYGIENE 9

Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course the students are expected to

CO1 Be aware of the different methods applied to processing foods.

CO2 Be able to understand the significance of food processing and the role of foodand beverage industries in the supply of foods.

TEXT BOOKS/REFERENCES:

1. Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”. Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M “Food Preservation and Safety Principles and Practice”.Surbhi Publications, 2001.
3. Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005.

OPY352 IPR FOR PHARMA INDUSTRY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level.
- To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications.
- This paper is to study significance of the amended patent act on pharma industry.

UNIT I INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS 9

Introduction, Types of Intellectual Property Rights -patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT II PATENTS 9

Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non-obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

UNIT III PLANT VARIETY-TRADITIONAL KNOWLEDGE –GEOGRAPHICAL INDICATIONS 9

Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under Intellectual Property frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications – Justification for protection, National and International position.

UNIT IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR 9

Introduction – civil remedies – injunction, damage, account of profit – criminal remedies – patent, trademark. Practical aspects – Introduction, benefits of licensing, licensing of basic types of IPR, licensing clauses of IPR. Case studies of patent infringement, compulsory licensing, simple patent license agreements.

UNIT V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY 9

International Background of Intellectual Property- Paris Convention, Berne convention, World Trade Organization (WTO), World Intellectual Property Organization (WIPO), Trade Related Aspects of Intellectual Property Rights (TRIPS) and Patent Co-operation Treaty (PCT).

TOTAL:45 PERIODS

TEXT BOOKS:

1. N. Nagpal, M. Arora, M.R.D. Usman, S. Rahar, “Intellectual Property Rights” Edu creation Publishing, New Delhi, 2017.
2. The Patents Act, 1970 (Bare Act with Short Notes) (New Delhi: Universal Law Publishing Company Pvt. Ltd. 2012.
3. B.S. Rao, P.V. Appaji, “Intellectual Property Rights in Pharmaceutical Industry: Theory and Practice”, 2015.

REFERENCES:

1. Patents for Chemicals, Pharmaceuticals, & Biotechnology-Fundamentals of Global Law, Practice and Strategy. Philip W. Grubb, Oxford University Press, 2004.
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005
3. S. Lakshmana Prabu, TNK. Suriyaprakash, “Intellectual Property Rights”, 1st ed., In Tech open access, Croatia, 2017.

COURSE OUTCOME

The student will be able to

C1 Understand and differentiate the categories of intellectual property rights.
C2 Describe about patents and procedure for obtaining patents.
C3 Distinguish plant variety, traditional knowledge and geographical indications under IPR.
C4 Provide the information about the different enforcements and practical aspects involved in protection of IPR.
C5 Provide different organizations role and responsibilities in the protection of IPR in the

international level.

C6 Understand the interrelationships between different Intellectual Property Rights on International Society

CO's-PO's & PSO's MAPPING												
IPR FOR PHARMA INDUSTRY												
	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO 12
C1	3	3		2					2	2		
C2		3	3				2	2				
C3	3	3					2	2				1
C4					2		3	3		2	2	
C5		3					3			2		1
C6	3	2				2	2					2

1 - low, 2 - medium, 3 - high, '-' - no correlation

OTT351 BASICS OF TEXTILE FINISHING L T P C
3 0 0 3

COURSE OBJECTIVE:

- To enable the students to understand the basics and different types of finishes required for textile materials and machines used for finishing.

UNIT I RESIN FINISHING 9

Importance of finishing and its classification. Resin finishing: Mechanism of creasing, Types of Resins .Anti crease, wash and wear, durable press resin finishing. Study about eco friendly method of anti crease finishing.

UNIT II FLAME PROOF & WATERPROOF 9

Concept of Flame proof & flame retardancy. Flame retardant finishes for cotton, Concept of waterproof and water repellent Finishes, Durable & Semi durable and Temporary finishes, Concept of Antimicrobial finish.

UNIT III SOIL RELEASE AND ANTISTATIC FINISHES 9

Soil Release Finishing: Mechanism of soil retention & soil release. Anti pilling Finishing: chemical and mechanical methods to produce anti pilling. Concept of UV Protection finishes- Concept of antistatic finishes.

UNIT IV MECHANICAL FINISHES 9

Mechanical finishing of textile materials - calendaring, compacting, Sanforising, Peach finishing. Object of Heat setting. Various methods of heat setting and mechanism of heat setting.

UNIT V STIFFENING AND SOFTENING 9

Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET .Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to Understand the

CO: 1 Basics of Resin Finishing Process.

CO: 2 Concept of Flame proof & flame retardancy, waterproof and water repellent, Antimicrobial finishes.

CO: 3 Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.

CO: 4 Concept of Mechanical finishing.

CO: 5 Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.

TEXT BOOKS:

1. V.A.Shennai, "Technology of Finishing", Vol X, Sevak Publications, Mumbai
2. Perkins, W.S., “Textile colouration and finishing”, Carolina Academic Press., U.K, ISBN: 0890898855.2004.

REFERENCES:

1. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62
2. Chakraborty, J.N, Fundamentals and Practices in colouration of Textiles, Woodhead Publishing India, 2009, ISBN-13:978-81-908001-4-3
3. W. D. Schindler and P. J. Hauser "Chemical finishing of textiles", Woodhead Publishing Cambridge England,2004.

OTT352 INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY L T P C

3 0 0 3

COURSE OBJECTIVES:

- To enable the students to learn about basics of industrial engineering and different tools of industrial engineering and its application in apparel industry

UNIT I INTRODUCTION 9

Scope of industrial engineering in apparel Industry, role of industrial engineers.

Productivity: Definition - Productivity, Productivity measures .Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.

UNIT II WORK STUDY 9

Definition, Purpose, Basic procedure and techniques of work-study.

Work environment – Lighting, Ventilation, Climatic condition on productivity. Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment

Material Handling – Objectives, Classification and characteristics of material handling equipments, Specialized material handling equipments.

UNIT III METHOD STUDY 9

Definition, Objectives, Procedure, Process charts and symbols. Various charts – Charts indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart

MOTION STUDY: Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart.

UNIT IV WORK MEASUREMENT 9

Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD.

UNIT V WORK STUDY APPLICATION 9

Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the completion of the course the student shall be able to understand

CO1: Fundamental concepts of industrial Engineering and productivity
CO2: Method study
CO3: Motion analysis
CO4: Work measurement and SAM
CO5: Ergonomics and its application to garment industry

TEXTBOOKS:

1. George Kanwaty, “Introduction to Work Study “, ILO, Geneva, 1996, ISBN: 9221071081 |ISBN-13: 9789221071082
2. Enrick N. L., “Time study manual for Textile industry”, Wiley Eastern (P) Ltd., 1989, ISBN: 0898740444 | ISBN-13: 9780898740448
3. Khanna O. P., and Sarup A., “Industrial Engineering and Management”, Dhanpat Rai Publications, New Delhi, 2010, ISBN: 818992835X / ISBN: 978-8189928353

REFERENCES

1. Norberd Lloyd Enrick., “Industrial Engineering Manual for Textile Industry”, Wiley Eastern (P) Ltd., New Delhi, 1988, ISBN: 0882756311 | ISBN-13: 9780882756318
2. Chuter A. J., “Introduction to Clothing Production Management”, Wiley-Black well Science, U.S. A., 1995, ISBN: 0632039396 | ISBN-13: 9780632039395
3. GordanaColovic., “Ergonomics in the garment industry”, Wood publishing India Pvt. Ltd., India, 2014, ISBN: 0857098225 | ISBN-13: 9780857098221
4. Rajesh Bheda, “Managing Productivity in Apparel Industry “CBS Publishers & Distributors, 2008

CO’s-PO’s & PSO’s MAPPING:

Course Outcomes	Statement	Program Outcome														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O3
CO1	Fundamental concepts of industrial Engineering and productivity	2	2	3	3	2	1	1	2	2	1	2	2	1	1	-
CO2	Method study	1	2	3	3	2	1	1	2	2	1	2	2	1	1	-
CO3	Motion	1	2	3	3	2	1	1	2	2	1	2	2	1	1	-

	analysis															
CO4	Work measurement and SAM	1	2	3	3	2	1	1	2	2	1	3	2	1	1	-
CO5	Ergonomics and its application to garment industry	1	2	3	3	2	1	2	2	2	1	3	2	1	1	-
Overall CO		1.2	2	3	3	2	1	1.2	2	2	1	2.4	2	1	1	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OTT353 BASICS OF TEXTILE MANUFACTURE L T P C
3 0 0 3

COURSE OBJECTIVES:

To enable the students to learn about the basics of fibre forming, yarn production, fabric formation, coloration of fabrics and garment manufacturing

UNIT I NATURAL FIBRES 9

Introduction: Definition of staple fibre, filament; Classification of natural and man-made fibres, essential and desirable properties of fibres. Production and cultivation of Natural Fibers: Cultivation of cotton, production of silk (sericulture), wool and jute – physical and chemical structure of these fibres..

UNIT II REGENERATED AND SYNTHETIC FIBRES 9

Production sequence of regenerated and modified cellulosic fibres: viscose rayon, Acetate Rayon, high wet modulus and high tenacity fibres; synthetic fibres – chemical structure, fibre forming polymers, production principles.

UNIT III BASICS OF SPINNING 9

Spinning – principle of yarn formation, sequence of machines for yarn production with short staple fibres and blends, principles of opening and cleaning machines; yarn numbering - calculation

UNIT IV BASICS OF WEAVING 9

Woven fabric – warp, weft, weaving, path of warp; looms – classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms,

UNIT V BASICS OF KNITTING AND NONWOVEN 9

Knitting – classification, principle, types of fabrics; nonwoven process –classification, principle,

types of fabrics.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the students shall have the basic knowledge on

CO1: Classification of fibres and production of natural fibres

CO2: Regenerated and synthetic fibres

CO3: Yarn spinning

CO4: Weaving

CO5: Knitting and nonwoven

TEXTBOOKS

1. Mishra S. P. , “A Text Book of Fibre Science and Technology”, New Age Publishers, 2000, ISBN: 8122412505
2. Marks R., and Robinson. T.C., “Principles of Weaving”, The Textile Institute, Manchester, 1989, ISBN: 0 900739 258.
3. Spencer D.J., “Knitting Technology”, III Ed., Textile Institute, Manchester, 2001, ISBN: 185573 333 1.

REFERENCES:

1. Hornberer M., Eberle H., Kilgus R., Ring W. and Hermeling H., “Clothing Technology: From Fibre to Fabric”, Europa LehrmittelVerlag, 2008, ISBN: 3808562250 / ISBN: 978-3808562253.
2. Wynne A., “Motivate Series-Textiles”, Maxmillan Publications, London, 1997.
3. Carr H. and Latham B., “The Technology of Clothing Manufacture” Backwell Science, U.K., 1994, ISBN: 0632037482 / ISBN:13: 9780632037483.Klein W., “The Rieter Manual of Spinning, Vol.1”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-1-4 / ISBN 13 978-3-9523173-1-0.
4. Klein W., “The Rieter Manual of Spinning, Vol.2”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-2-2 / ISBN 13 978-3-9523173-2-7.
5. Klein W., “The Rieter Manual of Spinning, Vol.1-3”, Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-3-0 / ISBN 13 978-3-9523173-3-4.
6. Talukdar. M.K., Sriramulu. P.K., and Ajgaonkar. D.B., “Weaving: Machines, Mechanisms, Management”, Mahajan Publishers, Ahmedabad, 1998, ISBN: 81-85401-16-0.
7. Morton W. E., and Hearle J. W. S., “Physical Properties of Textile Fibres”, The Textile Institute, Washington D.C., 2008, ISBN 978-1-84569-220-95
8. Gohl E. P. G., “Textile Science”, CBS Publishers and distributors, 1987, ISBN 0582685958

CO's-PO's & PSO's MAPPING

Course Outcomes	Statement	Program Outcome													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	Classification of fibres and production of natural fibres	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO2.	Regenerated and synthetic fibres	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO3.	Yarn spinning	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO4.	Weaving	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO5.	Knitting and nonwoven	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
Overall CO		-	-	-	-	-	-	-	2	1	-	1	1	-	1	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

OPE351 INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS

L T P C
3 0 0 3

COURSE OBJECTIVE:

The course is aimed to

Gain knowledge about petroleum refining process and production of petrochemical products.

UNIT I ORIGIN, FORMATION AND REFINING OF CRUDE OIL 9

Origin, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Refining of Petroleum - Atmospheric and Vacuum Distillation.

UNIT II CRACKING 9

Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen

UNIT III REFORMING AND HYDROTREATING 9

Catalytic Reforming of Petroleum Feed Stocks. Lube oil processing- Solvent Treatment Processes, Dewaxing, Clay Treatment and Hydrofining. Treatment Techniques: Removal of Sulphur Compounds in all Petroleum Fractions to improve performance.

UNIT IV INTRODUCTION TO PETROCHEMICALS 9

Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, and Extraction of Aromatics.

UNIT V PRODUCTION OF PETROCHEMICALS 9

Production of Petrochemicals like Dimethyl Terephathalate(DMT), Ethylene Glycol, Synthetic

glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol, Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and production of Carbon Black.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.

CO2: Understand the insights of primary treatment processes to produce the precursors.

CO3: Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.

CO4: Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.

CO5: Understand the societal impact of petrochemicals and learn their manufacturing processes.

CO6: Learn the importance of optimization of process parameters for the high yield of petroleum products.

TEXT BOOKS

1. Nelson, W. L., “Petroleum Refinery Engineering”, 4th Edition., McGraw Hill, New York,1985.
2. Wiseman. P., "Petrochemicals", UMIST Series in Science and Technology, John Wiley & Sons,1986.

REFERENCES

1. Bhaskara Rao, B. K., “Modern Petroleum Refining Processes”, 2nd Edition, Oxford and IBH Publishing Company, New Delhi, 1990.
2. Bhaskara Rao, B. K. “A Text on Petrochemicals”, 1st Edition, Khanna Publishers

CPE334 ENERGY CONSERVATION AND MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

At the end of the course, the student is expected to

- understand and analyse the energy data of industries
- carryout energy accounting and balancing
- conduct energy audit and suggest methodologies for energy savings and
- utilise the available resources in optimal ways

UNIT I INTRODUCTION 9

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II ELECTRICAL SYSTEMS 9

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III THERMAL SYSTEMS 9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V ECONOMICS 9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students can able to analyze the energy data of industries.

CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.

CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.

CO3: Skills on combustion thermodynamics and kinetics.

CO4: Apply calculation and design tube still heaters.

CO5: Studied different heat treatment furnace.

CO6: Practical and theoretical knowledge burner design.

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com. a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982
4. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987

OPT351 BASICS OF PLASTICS PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES

- Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on
- To gain practical knowledge on the polymer selection and its processing
- Understanding the major plastic material processing techniques (Extrusion, Injection molding, Compression and Transfer molding, Blow molding, Thermoforming and casting)
- To understand suitable additives for plastics compounding
- To Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques

UNIT I INTRODUCTION TO PLASTICS PROCESSING 9

Introduction to plastic processing – Principles of plastic processing: processing of plastics vs. metals and ceramics. Factors influencing the efficiency of plastics processing: molecular weight, viscosity and rheology. Difference in approach for thermoplastic and thermoset processing. Additives for plastics compounding and processing: antioxidants, light stabilizers, UV stabilizers, lubricants, impact modifiers, flame retardants, antistatic agents, stabilizers and plasticizers. Compounding: plastic compounding techniques, plasticization, pelletization.

UNIT II EXTRUSION 9

Extrusion – Principles of extrusion. Features of extruder: barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, types of extruders. Flow mechanism: process variables, die entry effects and exit instabilities. Die swell, Defects: melt fracture, shark skin, bambooing. Factors determining efficiency of an extruder. Extrusion of films: blown and cast films. Tube/pipe extrusion. Extrusion coating: wire & cable. Twin screw extruder and its applications. Applications of extrusion and new developments.

UNIT III INJECTION MOLDING 9

Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermosetting injection moulding. Injection moulding vs. other plastic processing techniques. State-of-the art injection moulding techniques - Introduction to trouble shooting

UNIT IV COMPRESSION AND TRANSFER MOLDING 9

Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms-Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating- Techniques of preheating. Machines used-Types of compression mould-positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding

UNIT V BLOW MOLDING, THERMOFORMING AND CASTING 9

Blow moulding: principles and terminologies. Injection blow moulding. Extrusion blow moulding. Design guidelines for optimum product performance and appearance. Thermoforming: principle, vacuum forming, pressure forming mechanical forming. Casting: working principle, types and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Ability to find out the correlation between various processing techniques with product properties.

CO2: Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.

CO3: Acquire knowledge on additives for plastic compounding and methods employed for the same

CO4: Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.

CO5: Select an appropriate processing technique for the production of a plastic product

REFERENCES

1. S. S. Schwart, S. H. Goodman, Plastics Materials and Processes, Van Nostrad Reinhold Company Inc. (1982).
2. F. Hensen (Ed.), Plastic Extrusion Technology, Hanser Gardner (1997).
3. W. S. Allen and P. N. Baker, Hand Book of Plastic Technology, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors (2004).
4. M. Chanda, S. K. Roy, Plastic Technology handbook, 4th Edn., CRC Press (2007).
5. I. I. Rubin, Injection Molding Theory & Practice, Society of Plastic Engineers, Wiley (1973).
6. D.V. Rosato, M. G. Rosato, Injection Molding Hand Book, Springer (2012).
7. M. L. Berins (Ed.), SPI Plastic Engineering Hand Book of Society of Plastic Industry Inc., Springer (2012).
8. B. Strong, Plastics: Material & Processing, A, Pearson Prentice hall (2005).
9. D.V Rosato, Blow Molding Hand Book, Carl HanserVerlag GmbH & Co (2003).

OEC351 SIGNALS AND SYSTEMS L T P C

3 0 0 3

COURSE OBJECTIVES :

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant& Time-invariant,Causal & Non-causal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 9

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

Impulse response–Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1:determine if a given system is linear/causal/stable
CO2: determine the frequency components present in a deterministic signal
CO3:characterize continuous LTI systems in the time domain and frequency domain
CO4:characterize discrete LTI systems in the time domain and frequency domain
CO5:compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

1. Oppenheim, Willsky and Hamid, “Signals and Systems”, 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)
2. Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley, 2002

REFERENCES :

1. B. P. Lathi, “Principles of Linear Systems and Signals”, 2nd Edition, Oxford, 2009.
2. M. J. Roberts, “Signals and Systems Analysis using Transform methods and MATLAB”, McGraw- Hill Education, 2018.
3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

CO’s-PO’s & PSO’s MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	-	3	2	-	-	-	-		3	-	-	1
2	3	-	3	-	-	2	-	-	-	-		3	-	3	-
3	3	3	-	-	3	2	-	-	-	-		3	2	-	-
4	3	3	-	-	3	2	-	-	-	-		3	-	3	1
5	3	3	-	3	3	2	-	-	-	-		3	-	3	1
C	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**1**

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

OEC352 FUNDAMENTALS Of ELECTRONIC DEVICES AND CIRCUITS L T P C
3 0 0 3

COURSE OBJECTIVES :

- To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits
- To analyze the frequency response of small signal amplifiers
- To design and analyze single stage and multistage amplifier circuits
- To study about feedback amplifiers and oscillators principles
- To understand the analysis and design of multi vibrators

UNIT I SEMICONDUCTOR DEVICES 9

PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator

UNIT II AMPLIFIERS 9

Load line, operating point, biasing methods for BJT and MOSFET**,** BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT III MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – Analysis of Voltage / Current, Series , Shunt feedback Amplifiers – positive feedback–Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

UNIT V POWER AMPLIFIERS AND DC/DC CONVERTERS 9

Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course the students will be able to

CO1: Explain the structure and working operation of basic electronic devices.
CO2: Design and analyze amplifiers.
CO3: Analyze frequency response of BJT and MOSFET amplifiers
CO4: Design and analyze feedback amplifiers and oscillator principles.
CO5: Design and analyze power amplifiers and supply circuits

TEXT BOOKS :

1. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5 th Edition, 2010.
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008.

3. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition, 2014.

REFERENCES :

1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition, 2010.
2. D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989
3. Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004.

CO's-PO's & PSO's MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
1	3	3	3	3	2	1	-	-	-	-	-	1	2	1	1
2	3	2	2	3	2	2	-	-	-	-	-	1	2	1	1
3	3	3	3	2	1	2	-	-	-	-	-	1	2	1	1
4	3	3	2	3	2	2	-	-	-	-	-	1	2	1	1
5	3	2	3	2	2	1	-	-	-	-	-	1	2	1	1
CO	**3**	**3**	**3**	**3**	**2**	**2**	-	-	-	-	-	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

OMA352 OPERATIONS RESEARCH L T P C
3 0 0 3

COURSE OBJECTIVES:

This course will help the students to

- determine the optimum solution for Linear programming problems.
- study the Transportation and assignment models and various techniques to solve them.
- acquire the knowledge of optimality, formulation and computation of integer programming problems.
- acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
- determine the optimum solution for non-linear programming problems.

UNIT I LINEAR PROGRAMMING 9

Formulation of linear programming models – Graphical solution – Simplex method - Big M Method – Two phase simplex method - Duality - Dual simplex method.

UNIT II TRANSPORTATION AND ASSIGNMENT PROBLEMS 9

Matrix form of Transportation problems – Loops in T.P – Initial basic feasible solution – Transportation algorithm – Assignment problem – Unbalanced assignment problems .

UNIT III INTEGER PROGRAMMING 9

Introduction – All and mixed I.P.P – Gomory's method – Cutting plane algorithm – Branch and bound algorithm – Zero – one programming.

UNIT IV DYNAMIC PROGRAMMING PROBLEMS 9

Recursive nature of computation – Forward and backward recursion – Resource Allocation model – Cargo – loading model – Work – force size model - Investment model – Solution of L.P.P by dynamic programming .

UNIT V NON - LINEAR PROGRAMMING PROBLEMS 9

Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn – Tucker Conditions – Quadratic programming.

TOTAL:45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1: Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.

CO2: analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.

CO3: solve the integer programming problems using various methods.

CO4: conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.

CO5: determine the optimum solution for non linear programming problems.

TEXT BOOKS:

1. Kanti Swarup, P.K.Gupta and Man Mohan, " Operations Research " , Sultan Chand & Sons, New Delhi, Fifth Edition , 1990.
2. Taha. H.A, " Operations Research – An Introduction , Pearson Education, Ninth Edition , New Delhi, 2012.

REFERENCES :

1. J.K.Sharma , " Operations Research - Theory and Applications " Mac Millan India Ltd , Second Edition , New Delhi , 2003.
2. Richard Bronson & Govindasami Naadimuthu , " Operations Research " (Schaum's Outlines – TMH Edition) Tata McGraw Hill, Second Edition, New Delhi, 2004.
3. Pradeep Prabhakar Pai , " Operations Research and Practice", Oxford University Press, New Delhi , 2012.
4. J.P.Singh and N.P.Singh , " Operations Research , Ane Books Pvt.L.td, New Delhi , 2014.
5. F.S.Hillier and G.J. Lieberman, " Introduction to Operations Research " , Tata McGraw Hill, Eighth Edition , New Delhi, 2005.

CO's-PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO2	3	3	3	2	0	0	0	0	2	0	0	2	-	-	-
CO3	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO4	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO5	3	3	2	2	0	0	0	0	2	0	0	2	-	-	-
Avg	3	3	1	0.8	0	0	0	0	2	0	0	2	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

OMA353 **ALGEBRA AND NUMBER THEORY** **L T P C**
3 0 0 3

COURSE OBJECTIVES :

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

UNIT I GROUPS AND RINGS 9

Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem.
Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism.

UNIT II FINITE FIELDS AND POLYNOMIALS 9

Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.

UNIT III DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS 9

Division algorithm- Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.

UNIT IV DIOPHANTINE EQUATIONS AND CONGRUENCES 9

Linear Diophantine equations – Congruence's – Linear Congruence's - Applications : Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems.

UNIT V CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS 9

Wilson's theorem – Fermat's Little theorem – Euler's theorem – Euler's Phi functions – Tau and Sigma functions.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

CO1: Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
CO2: Demonstrate accurate and efficient use of advanced algebraic techniques.
CO3: The students should be able to demonstrate their mastery by solving non-trivial problems related to the concepts, and by proving simple theorems about the, statements proven by the text

TEXT BOOKS :

1. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, New Delhi, 2007.
2. Thomas Koshy, "Elementary Number Theory with Applications", Elsevier Publications , New Delhi , 2002.

REFERENCES:

1. San Ling and Chaoping Xing, "Coding Theory – A first Course", Cambridge Publications, Cambridge, 2004.

2. Niven.I, Zuckerman.H.S., and Montgomery, H.L., “An Introduction to Theory of Numbers” , John Wiley and Sons , Singapore, 2004.
3. Lidl.R., and Pitz. G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2nd Edition , 2006.

CO’s-PO’s & PSO’s MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1	2	-	-	-	2	1	-	1	2	2	-	-	-
CO2	3	3	1	1	3	1	2	1	1	1	2	2	-	-	-
CO3	3	3	2	1	3	1	3	1	1	1	2	3	-	-	-
CO4	3	3	2	2	3	2	2	1	1	1	2	3	-	-	-
CO5	2	2	1	-	3	1	2	1	1	1	3	3	-	-	-
Avg	2.8	2.4	1.6	0.8	2.4	1	2.2	1	0.8	1	2.2	2.6	-	-	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

OMA354 LINEAR ALGEBRA L T P C
3 0 0 3

COURSE OBJECTIVES:

- To test the consistency and solve system of linear equations.
- To find the basis and dimension of vector space.
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
- To find orthonormal basis of inner product space and find least square approximation.
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS 9

Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordan method.

UNIT II VECTOR SPACES 9

Vector spaces over Real and Complex fields - Subspace – Linear space - Linear independence and dependence - Basis and dimension.

UNIT III LINEAR TRANSFORMATION 9

Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem– Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Diagonalization.

UNIT IV INNER PRODUCT SPACES 9

Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.

UNIT V EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION 9

Eigen value Problems : Power method, Jacobi rotation method - Singular value decomposition – QR decomposition.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After the completion of the course the student will be able to

CO1: Test the consistency and solve system of linear equations.

CO2: Find the basis and dimension of vector space.

CO3: Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.

CO4: Find orthonormal basis of inner product space and find least square approximation.

CO5: Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

TEXT BOOKS

1. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002.
2. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Pearson Education, 5th Edition,2019.

REFERENCES

1. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, 8th Edition, 2009.
2. Gerald C.F. and Wheatley P.O, Applied Numerical Analysis, Pearson Educations, New Delhi, 7th Edition, 2007.
3. Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010.
4. Richard Branson, Matrix Operations, Schaum's outline series, 1989.
5. Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi, 4th Edition, 2005.
6. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2014.

CO's-PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	2	2	2	1	1	1	1	3	-	-	-
CO2	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO3	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO4	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO5	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
Avg	3	3	3	3	2.8	2	2	1	1	1	1	3	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

OCE353 LEAN CONCEPTS, TOOLS AND PRACTICES L T P C

3 0 0 3

COURSE OBJECTIVE:

- To impart knowledge about the basics of lean principles, tools and techniques, and implementation in the construction industry.

UNIT I INTRODUCTION 9

Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems - Productivity in Construction - Daily Progress Report-The state of the industry with respect to its management practices -construction project phases - The problems with current construction management techniques.

UNIT II LEAN MANAGEMENT 9

Introduction to lean management - Toyota's management principle-Evolution of lean in construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design - Lean project delivery system- Forms of waste in construction industry - Waste Elimination.

UNIT III CORE CONCEPTS IN LEAN 9

Concepts in lean thinking – Principles of lean construction – Variability and its impact – Traditional construction and lean construction – Traditional project delivery - Lean construction and workflow reliability – Work structuring – Production control.

UNIT IV LEAN TOOLS AND TECHNIQUES 9

Value Stream Mapping – Work sampling – Last planner system – Flow and pull based production – Last Planner System – Look ahead schedule – constraint analysis – weekly planning meeting- Daily Huddles – Root cause analysis – Continuous improvement – Just in time.

UNIT V LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY 9

Lean construction implementation- Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach.

TOTAL : 45 PERIODS

COURSE OUTCOME:

On completion of this course, the student is expected to be able to

CO1 Explains the contemporary management techniques and the issues in present scenario.
CO2 Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.
CO3 Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.
CO4 Apply lean techniques to achieve sustainability in construction projects.
CO5 Apply lean construction techniques in design and modeling.

REFERENCES:

1. Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013.
2. Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.
3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., andTzortzopoulos, P.,Implementing lean in construction: Lean construction and BIM, CIRIA, 2013.
4. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.
5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.

OBT352 BASICS OF MICROBIAL TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVE:

- Enable the Non-biological student's to understand about the basics of life science and their pro and cons for living organisms.

UNIT I BASICS OF MICROBES AND ITS TYPES 9

Introduction to microbes, existence of microbes, inventions of great scientist and history, types of microorganisms – Bacteria, Virus, Fungi.

UNIT II MICROBIAL TECHNIQUES 9

Sterilization – types – physical and chemical sterilization, Decontamination, Preservation methods, fermentation, Cultivation and growth of microbes, Diagnostic methods.

UNIT III PATHOGENIC MICROBES 9

Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengu, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.

UNIT IV BENEFICIAL MICROBES 9

Applications of microbes – Clinical microbiology, agricultural microbiology, Food Microbiology, Environmental Microbiology, Animal Microbiology, Marine Microbiology.

UNIT V PRODUCTS FROM MICROBES 9

Fermentedproducts – Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products – Biopesticide, Biofertilizers, Vermi compost, Pharmaceutical products - Antibiotics, Vaccines

TOTAL: 45 PERIODS

COURSE OUTCOME:

At the end of the course the students will be able to

CO1: Microbes and their types
CO2: Cultivation of microbes
CO3: Pathogens and control measures for safety
CO4: Microbes in different industry for economy.

TEXT BOOKS

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.
2. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Prescott L.M., Harley J.P., Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.

OBT353 BASICS OF BIOMOLECULES L T P C
3 0 0 3

COURSE OBJECTIVES:

- The objective is to offer basic concepts of biochemistry to students with diverse background in life sciences including but not limited to the structure and function of various biomolecules and their metabolism.

UNIT I CARBOHYDRATES 9

Introduction to carbohydrate, classification, properties of monosaccharide, structural aspects of monosaccharides. Introduction to disaccharide (lactose, maltose, sucrose) and polysaccharide (Heparin, starch, and glycogen) biological function of carbohydrate.

UNIT II LIPID AND FATTY ACIDS 9

Introduction to lipid, occurrence, properties, classification of lipid. Importance of phospholipids, sphingolipid and glycerolipid. Biological function of lipid. Fatty acid, Introduction, Nomenclature and classification of fatty acid Essential and non essential fatty acids.

UNIT III AMINO ACIDS AND PROTEIN. 9

Introduction to amino acid, structure, classification of protein based on polarity. Introduction to protein, classification of protein based on solubility, shape, composition and Function. Peptide bond– Structure of peptide bond. Denauration – renaturation of protein, properties of protein. Introduction to lipoprotein, glycoprotein and nucleoprotein.Biological function of protein.

UNIT IV NUCLEIC ACIDS 9

Introduction to nucleic acid, Difference between nucleotide and nucleoside, composition of DNA & RNA Structure of Nitrogen bases in DNA and RNA along with the nomenclature· DNA double helix (Watson and crick) model, types of DNA, RNA.

UNIT V VITAMINS AND HORMONES 9

Different types of vitamins, their diverse biochemical functions and deficiency related diseases. Overview of hormones. Hormone mediated signaling. Mechanism of action of steroid hormones, epinephrine, glucagons and insulin.Role of vitamins and hormones in metabolism; Hormonal disorders; Therapeutic uses ofvitamins and hormones.

COURSE OUTCOMES:

CO1: Students will learn about various kinds of biomolecules and their physiological role.

CO2: Students will gain knowledge about various metabolic disorders and will help them to know the importance of various biomolecules in terms of disease correlation.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Cox W.H.Freeman and Company 2017
2. Satyanarayana, U. and U. Chakerapani, “Biochemistry” 3rd Rev. Edition, Books & Allied (P) Ltd., 2006. 3. Rastogi, S.C. “Biochemistry” 2nd Edition, Tata McGraw-Hill, 2003.
4. Conn, E.E., etal., “Outlines of Biochemistry” 5th Edition, John Wiley & Sons, 1987.
5. Outlines of Biochemistry, 5th Edition: By E E Conn, P K Stumpf, G Bruening and R Y Doi.pp 693. John Wiley and Sons, New York. 1987.

REFERENCES

1. Berg, Jeremy M. et al. “Biochemsitry”, 6th Edition, W.H. Freeman & Co., 2006.
2. Murray, R.K., etal “Harper’s Illustrated Biochemistry”, 31st Edition, McGraw-Hill, 2018.
3. Voet, D. and Voet, J.G., “Biochemistry”, 4th Edition, John Wiley & Sons Inc., 2010.

OBT354 FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide knowledge on the fundamentals of cell biology.
- To understand the signalling mechanisms.
- Understand basic principles of molecular biology at intracellular level to regulate growth, division and development.

UNIT-I INTRODUCTION TO CELL 9

Cell, cell wall and Extracellular Matrix (ECM), composition, cellular dimensions, Evolution, Organisation, differentiation of prokaryotic and Eukaryotic cells, Virus, bacteria,cyanobacteria, mycoplasma and prions.

UNIT II CELL ORGANELLES 9

Molecular organisation, biogenesis and functin Mitochondria, endoplasmic reticulam, golgi apparatus, plastids, chloroplast, leucoplast, centrosome, lysosome, ribosome, peroxisome, Nucleus and nucleolus. Endo membrane system, concept of compartmentalisation.

UNIT III BIO-MEMBRANE TRANSPORT 9

Physiochemical properties of cell membranes. Molecular constitute of membranes, asymmetrical organisation of lipids and proteins. Solute transport across membrane's-fick's law, simple diffusion, passive-facilitated diffusion, active transport- primary and secondary, group translocation, transport ATPases, membrane transport in bacteria and animals. Transportmechanism- mobile carriers and pores mechanisms. Transport by vesicle formation, endocytosis, exocytosis, cell respiration.

UNIT IV CELL CYCLE 9

Cell cycle- Cell division by mitosis and meosis, Comparision of meosis and mitosis, regulation of cell cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell junction, cell cycle checkpoints.

UNIT V CENTRAL DOGMA 9

Overview of Central dogma DNA replication: Meselson & Stahl experiment, bi–directional DNA replication, Okazaki fragments. Structure and function of mRNA, rRNA and tRNA. RNA synthesis: Initiation, elongation and termination of RNA synthesis Introduction to Genetic code-Steps in translation: Initiation, Elongation and termination of protein synthesis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understanding of cell at structural and functional level.
CO2: Understand the central dogma of life and its significance.
CO3: Comprehend the basic mechanisms of cell division.

TEXTBOOKS:

1. Cooper, G.M. and R.E. Hansman "The Cell: A Molecular Approach", 8th Edition, Oxford University Press, 2018
2. Friefelder, David. "Molecular Biology." Narosa Publications, 1999
3. Weaver, Robert F. "Molecular Biology" IInd Edition, Tata McGraw-Hill, 2003.

REFERENCES:
1. Lodish H, Berk A, MatsudairaP,Kaiser CA, Krieger M, Schot MP, Zipursky L, Darnell J. Molecular Cell Biology, 6th Edition, 2007.
2. Becker, W.M. etal., "The World of the Cell", 9th Edition, Pearson Education, 2003.
3. Campbell, N.A., J.B. Recee and E.J. Simon "Essential Biology", VIIrd Edition, Pearson International, 2007.
4. Alberts, Bruce etal., "Essential Cell Biology", 4th Edition, W.W. Norton, 2013.

OPEN ELECTIVE IV

OHS352 **PROJECT REPORT WRITING** **L T P C**
3 0 0 3

COURSE OBJECTIVE
The Course will enable Learners to,
- Understand the essentials of project writing.
- Perceive the difference between general writing and technical writing
- Assimilate the fundamental features of report writing.
- Understand the essential differences that exist between general and technical writing.
- Learn the structure of a technical and project report.

UNITI **9**
Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.

UNIT II **9**
Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis.

UNIT III **9**
Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.

UNIT IV **9**
Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations - Recommendations – Conclusion – Bibliography.

UNIT V **9**
Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques.

TOTAL:45 PERIODS

COURSE OUTCOMES
By the end of the course, learners will be able to
CO1: Write effective project reports.
CO2: Use statistical tools with confidence.

CO3: Explain the purpose and intension of the proposed project coherently and with clarity.
CO4: Create writing texts to suit achieve the intended purpose.
CO5: Master the art of writing winning proposals and projects.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	1	1	3	2	2	3	3	3	3	-	-	-
2	2	2	2	1	1	1	2	1	2	3	2	3	-	-	-
3	2	2	3	3	2	3	2	2	2	3	2	3	-	-	-
4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
AVg.	2.4	2.2	2.4	2.2	2	2.6	2.4	2.2	2.6	3	2.6	3	-	-	-

1-low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

REFERENCES

1. Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall(2012)
2. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012)
3. Daniel Riordan - Technical Report Writing Today (1998)
   Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.

OMA355 ADVANCED NUMERICAL METHODS L T P C
3 0 0 3

COURSE OBJECTIVE:

- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology. This will also serve as a precursor for future research.

UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM 9

System of nonlinear equations : Fixed point iteration method - Newton's method; System of linear equations: Thomas algorithm for tri diagonal system - SOR iteration methods ; Eigen value problems: Given's method - Householder's method.

UNIT II INTERPOLATION 9

Central difference: Stirling and Bessel's interpolation formulae ; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline ; Least square approximation for continuous data (upto 3rd degree).

UNIT III NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS 9

Explicit Adams - Bashforth Techniques - Implicit Adams - Moulton Techniques, Predictor - Corrector Techniques - Finite difference methods for solving two - point linear boundary value problems - Orthogonal Collocation method.

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 9

Laplace and Poisson's equations in a rectangular region : Five point finite difference schemes - Leibmann's iterative methods - Dirichlet's and Neumann conditions – Laplace equation in polar coordinates : Finite difference schemes .

UNIT V FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS 9

Parabolic equations : Explicit and implicit finite difference methods – Weighted average approximation - Dirichlet's and Neumann conditions – First order hyperbolic equations - Method of characteristics - Different explicit and implicit methods; Wave equation : Explicit scheme – Stability of above schemes.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: demonstrate the understandings of common numerical methods for nonlinear equations, system of linear equations and eigenvalue problems;

CO2: understand the interpolation theory;

CO3: understand the concepts of numerical methods for ordinary differential equations;

CO4: demonstrate the understandings of common numerical methods for elliptic equations;

CO5: understand the concepts of numerical methods for time dependent partial differential equations

TEXT BOOKS :

1. Grewal, B.S., "Numerical Methods in Engineering & Science ", Khanna Publications, Delhi, 2013.
2. Gupta, S.K., "Numerical Methods for Engineers", (Third Edition), New Age Publishers, 2015.
3. Jain, M.K., Iyengar, S.R.K. and Jain, R.K., "Computational Methods for Partial Differential Equations", New Age Publishers, 1994.

REFERENCES:

1. Saumyen Guha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010.
2. Burden, R.L., and Faires, J.D., "Numerical Analysis – Theory and Applications", 9 th Edition, Cengage Learning, New Delhi, 2016.
3. Gupta S.K., "Numerical Methods for Engineers",4th Edition, New Age Publishers, 2019.
4. Sastry, S.S., "Introductory Methods of Numerical Analysis", 5th Edition, PHI Learning, 2015.
5. Morton, K.W. and Mayers D.F., "Numerical solution of Partial Differential equations", Cambridge University press, Cambridge, 2002.

CO's-PO's & PSO's MAPPING

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CO3	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO4	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
CO5	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-
Avg	3	3	3	3	3	2	2	1	1	1	1	3	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

OMA356 **RANDOM PROCESSES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in communication networks.
- To acquaint with specialized random processes which are apt for modelling the real time scenario.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT I RANDOM VARIABLES 9

Discrete and continuous random variables – Moments – Moment generating functions – Joint Distribution- Covariance and Correlation – Transformation of a random variable.

UNIT II RANDOM PROCESSES 9

Classification – Characterization – Cross correlation and Cross covariance functions - Stationary Random Processes – Markov process - Markov chain.

UNIT III SPECIAL RANDOM PROCESSES 9

Bernoulli Process – Gaussian Process - Poisson process – Random telegraph process.

UNIT IV CORRELATION AND SPECTRAL DENSITIES 9

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 9

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.

CO2: Apply the concept random processes in engineering disciplines.

CO3: Understand and apply the concept of correlation and spectral densities.

CO4: Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.

CO5: Analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS

1. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.

REFERENCES

1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.
3. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.
4. Stark. H. and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.
5. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

CO's-PO's & PSO's MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
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CO2	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO3	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO4	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
CO5	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-
Avg	3	3	0	0	0	0	0	0	3	0	0	2	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

OMA357 QUEUEING AND RELIABILITY MODELLING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the concept of queueing models and apply in engineering.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
- To study the system reliability and hazard function for series and parallel systems.
- To implement Markovian Techniques for availability and maintainability which opens up new avenues for research.

UNIT I RANDOM PROCESSES 9

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.

UNIT II MARKOVIAN QUEUEING MODELS 9

Markovian queues – Birth and death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms.

UNIT III ADVANCED QUEUEING MODELS 9

M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and $M/E_K/1$ as special cases – Series queues – Open Jackson networks.

UNIT IV SYSTEM RELIABILITY 9

Reliability and hazard functions- Exponential, Normal, Weibull and Gamma failure distribution – Time - dependent hazard models – Reliability of Series and Parallel Systems.

UNIT V MAINTAINABILITY AND AVAILABILITY 9

Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Enable the students to apply the concept of random processes in engineering disciplines.

CO2: Students acquire skills in analyzing various queueing models.

CO3: Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.

CO4: Students can analyze reliability of the systems for various probability distributions.

CO5: Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.

TEXT BOOKS

1. Shortle J.F, Gross D, Thompson J.M,Harris C.M., “Fundamentals of Queueing Theory”, John Wiley and Sons, New York,2018.
2. Balagurusamy E., “Reliability Engineering”, Tata McGraw Hill Publishing Company Ltd., New Delhi,2010.

REFERENCES

1. Medhi J, ”Stochastic models of Queueing Theory”, Academic Press, Elsevier, Amsterdam, 2003.
2. Taha, H.A., "Operations Research", 9th Edition, Pearson India Education Services, Delhi, 2016.
3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
4. Govil A.K., “Reliability Engineering”, Tata-McGraw Hill Publishing Company Ltd., New Delhi,1983.

CO’s-PO’s & PSO’s MAPPING

	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	0	0	0	0	0	0	2	0	0	2	-	-	-
CO2	3	3	2	0	0	0	0	0	2	0	0	2	-	-	-
CO3	3	3	0	2	0	0	0	0	2	0	0	2	-	-	-
CO4	3	3	2	0	0	0	0	0	2	0	0	2	-	-	-
CO5	3	3	3	2	0	0	0	0	2	0	0	2	-	-	-
Avg	3	3	1.4	0.8	0	0	0	0	2	0	0	2	-	-	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the basic concept and function of Production and Operation Management for entrepreneurship.
- To understand the Production process and planning.
- To understand the Production and Operations Management Control for business owners.

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANGEMENT 9

Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production /operations management - production as an organisational function, decision making in production Operations research

UNIT II PRODUCTION & OPERATION SYSTEMS 9

Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT III PRODUCTION & OPERATIONS PLANNING 9

Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS 9

Process selection with PLC phases- Process simulation tools- Work Study – Significance – Methods, evolution of normal/ standard time – Job design and rating - Value Analysis - Plant Layout: meaning – characters –- Plant location techniques - Types- MRP and Layout Design - Optimisation and Theory of Constraints (TOC)– Critical Chain Project Management (CCPM)- REL (Relationship) Chart – Assembly line balancing- – Plant design optimisation -Forecasting methods.

UNIT V CONTROLING PRODUCTION & OPERATIONS MANAGEMENT 9

Material requirement planning (MRP)- Concept- Process and control - Inventory control systems and techniques – JIT and Lean manufacturing - Network techniques - Quality Management: Preventive Vs Breakdown maintenance for Quality – Techniques for measuring quality - Control Chart (X , R , p , np and C chart) - Cost of Quality, Continuous improvement (Kaizen) - Quality awards - Supply Chain Management - Total Quality Management - 6 Sigma approach and Zero Defect Manufacturing.

TOTAL 45 : PERIODS

COURSE OUTCOMES:

Upon completion of this course the learners will be able :

CO 1 To understand the basics and functions of Production and Operation Management for business owners.

CO 2 To learn about the Production & Operation Systems.

CO 3 To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.
CO 4 To known about the Production & Operations Management Processes in organisations.
CO 5 To comprehend the techniques of controlling , Production and Operations in industries.

REFERENCES

1. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson, 2007.
2. Amitabh Raturi, Production and Inventory Management, , 2008.
3. Adam Jr. Ebert, Production and Operations Management, PHI Publication, 1992.
4. Muhlemann, Okland and Lockyer, Production and Operation Management, Macmillan India,1992.
6. Chary S.N, Production and Operations Management, TMH Publications, 2010.
7. Terry Hill ,Operation Management. Pal Grave McMillan (Case Study).2005.

OMG355 MULTIVARIATE DATA ANALYSIS

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To know various multivariate data analysis techniques for business research.

UNIT I INTRODUCTION **9**

Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation.

UNIT II PREPARING FOR MULTIVARIATE ANALYSIS **9**

Conceptualization of research model with variables, collection of data –-Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.

UNIT III MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS **9**

Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. -Approaches to factor analysis – interpretation of results.

UNIT IV LATENT VARIABLE TECHNIQUES **9**

Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.

UNIT V ADVANCED MULTIVARIATE TECHNIQUES **9**

Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

CO1: Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using multivariate techniques to provide constructive guidance in decision making.

CO2: Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.

CO3: Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.
CO4: Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.
CO5: Make better business decisions by using advanced techniques in data analytics. ‘

REFERENCES :

1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, Multivariate Data Analysis, Pearson Education, New Delhi, 2005.
2. Barbara G. Tabachnick, Linda S.Fidell, Using Multivariate Statistics, 6th Edition, Pearson, 2012.
3. Richard A Johnson and Dean W.Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, New Delhi, 2005.
4. David R Anderson, Dennis J Seveency, and Thomas A Williams, Statistics for Business and Economics, Thompson, Singapore, 2002

OME352	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities.
- To be acquainted with vat polymerization and material extrusion processes
- To be familiar with powder bed fusion and binder jetting processes.
- To gain knowledge on applications of direct energy deposition, and material jetting processes.
- To impart knowledge on sheet lamination and direct write technologies.

UNIT I INTRODUCTION 9

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain - ASTM/ISO 52900 Classification - Benefits - AM Unique Capabilities - AM File formats: STL, AMF Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare. Business Opportunities in AM.

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION 9

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications.
Material Extrusion: Fused Deposition Modeling (FDM) - Process-Materials -Applications and Limitations.

UNIT III POWDER BED FUSION AND BINDER JETTING 9

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications.
Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations - Applications.

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION 9

Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications.

Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery - Materials -Benefits -Applications.

UNIT V SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY 9

Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation.

Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course students shall be able to:

CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.

CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.

CO3: Elaborate the process and applications of powder bed fusion and binder jetting.

CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.

CO5: Acquire knowledge on sheet lamination and direct write technology.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani “Additive manufacturing technologies”. 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0
2. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCES:

1. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
5. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press., United States, 2011, ISBN: 9780849334092.

CME343	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamental concepts of the new product development
- To develop material specifications, analysis and process.
- To Learn the Feasibility Studies & reporting of new product development.
- To study the New product qualification and Market Survey on similar products of new product development
- To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT – I FUNDAMENTALS OF NPD 9

Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud – QFD.

UNIT – II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS 9

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT – III ESSENTIALS OF NPD 9

RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.

UNIT – IV CRITERIONS OF NPD 9

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT – V REPORTING & FORWARD-THINKING OF NPD 9

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Discuss fundamental concepts and customer specific requirements of the New Product development

CO2: Discuss the Material specification standards, analysis and fabrication, manufacturing process.

CO3: Develop Feasibility Studies & reporting of New Product development

CO4: Analyzing the New product qualification and Market Survey on similar products of new product development

CO5: Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXT BOOKS:

1. Product Development – Sten Jonsson
2. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCES:

1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
2. Change by Design
3. Toyota Product Development System – James Morgan & Jeffrey K. Liker
4. Winning at New Products – Robert Brands 3rd Edition
5. Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	3	1				1	1			1	1	3	2
2	1	1	3	1				1	1			1	1	3	2
3	1	1	3	1				1	1			1	1	3	2
4	1	1	3	1				1	1			1	1	3	2
5	1	1	3	1				1	1			1	1	3	2
Low (1) ; Medium (2) ; High (3)															

1 - low, 2 - medium, 3 - high, '-' - no correlation

OME355 INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES L T P C

3 0 0 3

COURSE OBJECTIVES:

The course aims to

- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices

UNIT I UI/UX **9**

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Color theory - Design process flow, wireframes,

best practices in the industry -User engagement ethics - Design alternatives

UNIT II APP DEVELOPMENT 9

SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

UNIT III INDUSTRIAL DESIGN 9

Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning & Tolerancing

UNIT IV MECHANICAL RAPID PROTOTYPING 9

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

UNIT V ELECTRONIC RAPID PROTOTYPING 9

Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, learners will be able to:

CO1: Create quick UI/UX prototypes for customer needs

CO2: Develop web application to test product traction / product feature

CO3: Develop 3D models for prototyping various product ideas

CO4: Built prototypes using Tools and Techniques in a quick iterative methodology

TEXT BOOKS

1. Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003)
2. Samar Malik, Autodesk Fusion 360 - The Master Guide.
3. Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Pearson,3rd edition(2014)

REFERENCES

1. https://www.adobe.com/products/xd/learn/get-star ted.html
2. https://developer.android.com/guide
3. https://help.autodesk.com/view/fusion360/ENU/courses/
4. https://help.prusa3d.com/en/categor y/prusaslicer_204

MF3010 MICRO AND PRECISION ENGINEERING LT P C
3 0 0 3

COURSE OBJECTIVES:

At the end of this course the student should be able to

- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I INTRODUCTION TO MICROSYSTEMS 9

Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II FABRICATION PROCESSES FOR MICRO-SYSTEMS: 9

Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices

UNIT III INTRODUCTION TO PRECISION ENGINEERING 9

Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick- slip mechanism and other piezo-based devices.

UNIT IV PRECISION MACHINING PROCESSES 9

Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.

UNIT V METROLOGY FOR MICRO SYSTEMS 9

Metrology for micro systems - Surface integrity and its characterization.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: Select suitable precision machine tools and operate

CO2: Apply the macro and micro components for fabrication of micro systems.

CO3: Apply suitable machining process

CO4: Able to work with miniature models of existing machine tools/robots and other instruments.

CO5: Apply metrology for micro system

TEXT BOOKS:

1. Davim, J. Paulo, ed. Microfabrication and Precision Engineering: Research and Development. Woodhead Publishing, 2017
2. Gupta K, editor. Micro and Precision Manufacturing. Springer; 2017

REFERENCES:

1. Dornfeld, D., and Lee, D. E., Precision Manufacturing, 2008, Springer.
2. H. Nakazawa, Principles of Precision Engineering, 1994, Oxford University Press.
3. Whitehouse, D. J., Handbook of Surface Metrology, Institute of Physics Publishing,

Philadelphia PA, 1994.
4. Murthy.R.L, —Precision Engineering in Manufacturingll, New Age International, New Delhi, 2005

OMF354 COST MANAGEMENT OF ENGINEERING PROJECTS LT P C
3 0 0 3

COURSE OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT – I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.'

UNIT – II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts

UNIT – III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing

UNIT – IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT – V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:
CO1: Understand the costing concepts and their role in decision making.
CO2: Understand the project management concepts and their various aspects in selection.
CO3: Interpret costing concepts with project execution.
CO4: Gain knowledge of costing techniques in service sector and various budgetary control

techniques.

CO5: Become familiar with quantitative techniques in cost management.

TEXT BOOKS:

1. John M. Nicholas, Herman Steyn Project Management for Engineering, Business and Technology, Taylor & Francis, 2 August 2020, ISBN: 9781000092561.
2. Albert Lester ,Project Management, Planning and Control, Elsevier/Butterworth-Heinemann, 2007, ISBN: 9780750669566, 075066956X.

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991.
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988.
3. Charles T. Horngren et al Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi, 2011.
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003.
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007.

AU3002 BATTERIES AND MANAGEMENT SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVES:

- The objective of this course is to make the students to understand the working and characteristics of different types of batteries and their management .

UNIT I ADVANCED BATTERIES 9

Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics-SOC,DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. *NCR18650B* specifications.

UNIT II BATTERY PACK 9

Battery Pack- design, sizing, calculations, flow chart, real and simulation Model.Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNITIII BATTERY MODELLING 9

Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models-Introduction. Battery Modelling software/simulation frameworks

UNIT IV BATTERY STATE ESTIMATION 9

SOC Estimation- Definition, importance, single cell Vs series batteries SOC. Estimation Methods-Load voltage, Electromotive force, AC impedance, Ah counting, Neural networks, Neuro-fuzzy forecast method, Kalman filter. Estimation Algorithms.

UNIT V BMS ARCHITECTURE AND REAL TIME COMPONENTS 9

Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-

CANedge1 package.ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

TOTAL =45 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1: Acquire knowledge of different Li-ion Batteries performance.
CO2: Design a Battery Pack and make related calculations.
CO3: Demonstrate a BatteryModel or Simulation.
CO4: Estimate State-of-Charges in a Battery Pack.
CO5: Approach different BMS architectures during real world usage.

TEXT BOOKS

1. Jiuchun Jiang and Caiping Zhang, "Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles'', Wiley, 2015.
2. Davide Andrea ,"Battery Management Systems for Large Lithium-Ion Battery Packs" ARTECH House, 2010.

REFERENCE BOOKS

1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper
2. Panasonic *NCR18650B- DataSheet*
3. bq76PL536A-Q1- IC DataSheet
4. CC2662R-Q1- IC DataSheet

AU3008 SENSORS AND ACTUATORS L T P C
3 0 0 3

COURSE OBJECTIVES:

- The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS 9

Sensors: Functions- Classifications- Main technical requirement and trends Units and standards- Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error- Propagation of error- Odds and uncertainty- principle of transduction-Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers- Dynamic characteristics of first and second order transducers for standard test inputs.

UNIT II VARIABLE RESISTANCE AND INDUTANCE SENSORS 9

Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS 9

Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV AUTOMOTIVE ACTUATORS 9

Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid,

relay, stepper motor etc.

UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS 9

Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

TOTAL =45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: List common types of sensor and actuators used in vehicles.

CO2: Design measuring equipment's for the measurement of pressure force, temperature and flow.

CO3: Generate new ideas in designing the sensors and actuators for automotive application

CO4: Understand the operation of thesensors, actuators and electronic control.

CO5: Design temperature control actuators for vehicles.

TEXT BOOKS:

1. Doebelin's Measurement Systems: 7th Edition (SIE),Ernest O. Doebelin DhaneshN.Manik McGraw Hill Publishers, 2019.
2. Robert Brandy, " Automotive Electronics and Computer System", Prentice Hall,2001
3. William Kimberley," Bosch Automotive Handbook", 6th Edition, Robert Bosch GmbH, 2004.
4. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5.

REFERENCES:

1. James D Halderman, " Automotive Electrical and Electronics" , Prentice Hall, USA, 2013
2. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International.
3. Patranabis.D, " Sensors and Transducers", 2nd Edition, Prentice Hall India Ltd,2003
4. William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.

OAS353 SPACE VEHICLES L T P C

3 0 0 3

COURSE OBJECTIVES:

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

UNIT I FUNDAMENTAL ASPECTS 9

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

UNIT II SELECTION OF ROCKET PROPULSION SYSTEMS 9

Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different

missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.

UNIT III ENGINE SYSTEMS, CONTROLS, AND INTEGRATION 9

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

UNIT IV THRUST VECTOR CONTROL 9

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

UNIT V NOSE CONE CONFIGURATION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.

CO2: Apply knowledge in selecting the appropriate rocket propulsion systems.

CO3: interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.

CO4: Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.

CO5: Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.

OIM352 MANAGEMENT SCIENCE L T P C

3 0 0 3

COURSE OBJECTIVES:

Of this course are

- To introduce fundamental concepts of management and organization to students.
- Toi mpart knowledge to students on various aspects of marketing, quality control and marketing strategies.
- To make students familiarize with the concepts of human resources management.
- To acquaint students with the concepts of project management and cost analysis.
- To make students familiarize with the concepts of planning process and business strategies.

UNITI INTRODUCTION TO MANAGEMENT AND ORGANISATION 9

Concepts of Management and organization- nature, importance and Functions of Management, Systems Approach to Management - Taylor's Scientific Management Theory- Fayal's Principles of Management- Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's TheoryXandTheoryY-HertzbergTwoFactorTheoryofMotivation-
LeadershipStyles,Socialresponsibilities of Management, Designing Organisational Structures: Basic concepts related to Organisation -Departmentation and Decentralisation.

UNITII OPERATIONS AND MARKETING MANAGEMENT 9

Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production),Work Study - Basic procedure involved in Method Study and Work Measurement - BusinessProcessReengineering(BPR)-
StatisticalQualityControl:controlchartsforVariablesandAttributes (simple Problems) and Acceptance Sampling, Objectives of Inventory control, EOQ,ABC Analysis, Purchase Procedure, Stores Management and Store Records - JIT System,Supply Chain Management, Functions of Marketing, Marketing Mix, and Marketing Strategies based on ProductLifeCycle.

UNITIII HUMAN RESOURCES MANAGEMENT 9

Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager:Manpower planning, Recruitment, Selection, TrainingandDevelopment,WageandSalaryAdministration,Promotion,Transfer,PerformanceAppraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating –Capability Maturity Model (CMM)Levels.

UNITIV PROJECT MANAGEMENT 9

Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method(CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis,Project Crashing (simple problems).

UNITV STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES 9

Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives. Bench Marking and Balanced Score Cardas Contemporary Business Strategies.

TOTAL: 45 PERIODS

OURSEOUTCOMES:

Upon completion of the course, Students will be able to

CO1:PlananorganizationalstructureforagivencontextintheorganisationtocarryoutproductionoperationsthroughWork-study.

CO2:Surveythemarkets,customersandcompetitionbetterandpricethegivenproductsappropriatey

CO3:Ensurequalityforagivenproduct or service.

CO4:Plan, schedule and control projects through PERTandCPM.

CO5:Evaluate strategyforabusiness orserviceorganisation.

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3			3	3	3		3	3	2			2	3	
2	3			2	3	3		2	3	2				2	
3	3			3	2	2		3	2	2					2
4	3			3	3	2		3	2	3					3
5	3			2	3	3		2	3	3			2	1	
AVg.	3			2.6	2.8	2.6		2.6	2.6	2.4			2	2	2.5

1 - low, 2 - medium, 3 - high, '-' - no correlation

TEXTBOOKS:

1. KanishkaBedi, Production and Operations Management,OxfordUniversityPress,2007.
2. Stoner,Freeman,Gilbert, Management,6th Ed, PearsonEducation,NewDelhi,2004.
3. ThomasN.Duening & John M.Ivancevich Management Principles and Guidelines, Biztantra,2007.
4. P.VijayKumar,N.Appa Rao and Ashnab, Chnalill, CengageLearning India,2012.

REFERECES:

1. KotlerPhilip and KellerKevinLane: Marketing Management, Pearson, 2012.
2. KoontzandWeihrich: Essentials of Management, McGrawHill, 2012.
3. Lawrence RJauch,R.Guptaand William F. Glueck: Business Policy and Strategic Management Science,McGrawHill,2012.
4. SamuelC.Certo:Modern Management,2012.

		L	T	P	C
OIM353	**PRODUCTION PLANNING AND CONTROL**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION 9

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNITII WORK STUDY 9

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNITIII PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNITIV PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems-

Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course,

CO1:The students can able to prepare production planning and control act work study,
CO2:The students can able to prepare product planning,
CO3:The students can able to prepare production scheduling,
CO4:The students can able to prepare Inventory Control.
CO5:They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:

1. James. B. Dilworth, "Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.

REFERENCES

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990
4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgraw hill.
6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007
7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
8. Upendra Kachru, " Production and Operations Management – Text and cases" 1st Edition, Excel books 2007

CO's-PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3			3		1				1		3		
2	3	2			3									2	
3		2			3									2	
4		2	2												
5	3	3	2											1	
AVg.	3	2.6	2		3		1				1		3	1.8	

1 - low, 2 - medium, 3 - high, '-' - no correlation

OIE353 **OPERATIONS MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT 9

Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy – Strategic fit , framework; Supply Chain Management

UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN 9

Demand Forecasting – Need, Types, COURSE OBJECTIVES and Steps. Overview of Qualitative and Quantitative methods. Capacity Planning - Long range, Types, Developing capacity alternatives. Overview of sales and operations planning. Overview of MRP, MRP II and ERP. Facility Location – Theories, Steps in Selection, Location Models. Facility Layout – Principles, Types, Planning tools and techniques.

UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS 9

Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Work Study – COURSE OBJECTIVES, Procedure. Method Study and Motion Study. Work Measurement and Productivity – Measuring Productivityand Methods to improve productivity.

UNIT IV MATERIALS MANAGEMENT 9

Materials Management – COURSE OBJECTIVES, Planning, Budgeting and Control. Purchasing – COURSE OBJECTIVES, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – COURSE OBJECTIVES, Costs and control techniques. Overview of JIT.

UNIT V SCHEDULING AND PROJECT MANAGEMENT 9

Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson"sAlgorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm's competitive advantages in the dynamic business environment.

CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.

CO3: The students will able to Formulate and Assess Aggregate Planning strategies and

Material Requirement Plan.

CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.

CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3											2			
2		3	3											3	3
3		2	3	3									2	3	
4		3	3	3									2	3	
5			3	2											
AVg.	3	2.6	3	2.6								2	2	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

TEXT BOOKS

1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations andSupply Management, Tata McGraw Hill, 12th Edition, 2010.
2. Norman Gaither and Gregory Frazier, Operations Management, South Western CengageLearning, 2002.

REFERENCES

1. William J Stevenson, Operations Management, Tata McGraw Hill, 9th Edition, 2009.
2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006.
3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
4. Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008.
5. Aswathappa K and Shridhara Bhat K, Production and Operations Management, HimalayaPublishing House, Revised Second Edition, 2008.
6. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007.
7. Pannerselvam R, Production and Operations Management, Prentice Hall India, Second Edition, 2008.

OSF352 **INDUSTRIAL HYGIENE** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
- Compare and contrast the roles of environmental and biological monitoring in work health and safety
- Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates
- Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures

- Provide high-level advice on managing and controlling noise and noise-related hazards

UNIT I : INTRODUCTION AND SCOPE 9

Occupational Health and Environmental Safety Management - Principles practices. Comm on Occupational diseases: Occupational Health Management Services at the work place. Pre-employment, periodic medical examination of workers, medical surveillance for control of occupational diseases and health records.

UNIT II : MONITORING FOR SAFETY, HEALTH & ENVIRONMENT 9

Occupational Health and Environment Safety Management System, ILO and EPA Standards Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III : OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION 9

Element of training cycle, Assessment of needs.Techniques of training, design and development of training programs.Training methods and strategies types of training.Evaluation and review of training programs. Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limit .

UNIT IV : OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT 9

Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM. Importance of Industrial safety, role of safety department,

UNIT-V INDUSTRIAL HAZARDS 9

i. Radiation: Types and effects of radiation on human body, Measurement and detection of radiation intensity. Effects of radiation on human body, Measurement – disposal of radioactive waste, Control of radiation ii. Noise and Vibration: Sources, and its control, Effects of noise on the auditory system and health, Measurement of noise , Different air pollutants in industries, Effect of different gases and particulate matter ,acid fumes ,smoke, fog on human health, Vibration: effects.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students able to

CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems

CO2: Specify designs that avoid occupation related injuries

CO3: Define and apply the principles of work design, motion economy, and work environment design.

CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.

CO5: Acknowledge the impact of workplace design and environment on productivity

TEXT BOOKS:

1. R. K. Jain and Sunil S. Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers, New Delhi (2006)
2. Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York .

REFERENCES:

1. Jeanne MagerStellman, Encyclopedia of Occupational Health and Safety (ILO) Ms. Irma Jourdan publication
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2,
3. ButterworthHeinemann Ltd., London (1991). 2. Industrial Safety - National Safety Council of India
4. Frank P Lees – Loss of prevention in Process Industries , Vol. 1 and 2, Butterworth- Heinemann Ltd., London
5. R. K. Jain and Sunil S. Rao, Industrial Safety , Health and Environment Management Systems, Khanna publishers, New Delhi (2006).

CO's- PO's & PSO's MAPPING

	PO's												PSO's		
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2		2		2	-	-	-	-	-	2	-	-	-	-
2	-		2		-	-	1	-	-	-	1	-	-	-	-
3	-		-		2	-	-	-	-	-	2	-	-	-	-
4	-		-		-	-	-	-	2	-	3	-	-	-	-
5	-		-		-	-	-	1	-	-	-	-	-	-	-
AVg.	2	-	2	-	-	-	1	1	2	-	2		-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

OSF353 CHEMICAL PROCESS SAFETY L T P C
3 0 0 3

COURSE OBJECTIVES

- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.
- Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
- Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES 9

Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II CHEMICAL REACTION HAZARDS 9

Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening,

UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS 9

Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS 9

Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards -standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures- condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V SAFETY AND ANALYSIS 9

Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students able to

CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.

CO2 Develop thorough knowledge about safety in the operation of chemical plants.

CO3 Apply the principles of safety in the storage and handling of gases.

CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.

CO5 Develop thorough knowledge about

TEXT BOOK

1 David A Crowl& Joseph F Louvar,"Chemical Process safety", Pearson publication, 3rd Edition,2014

2 Maurice Jones .A,"Fire Protection Systems,2nd edition, Jones & Bartlett Publishers,2015

REFERENCES:

1. Ralph King and Ron Hirst,"King´s safety in the process industries", Arnold, London, 1998.
2. Industrial Environment and its Evolution and Control, NIOSH Publication, 1973.
3. National Safety Council," Accident prevention manual for industrial operations". Chicago, 1982.
4. Lewis, Richard. J., Sr,"Sax´s dangerous properties of materials". (Ninth edition). Van Nostrand Reinhold, New York, 1996.
5. Roy E Sanders, "Chemical Process Safety",3rd Edition, Gulf professional publishing, 2006

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	-	-	-	1	-	-	1	-	-	-	2	-	-
2	-			2	-	-	-	-	1	-		-	-	2	-

3	-	3		1	-	-	-	2	-	-	1	-	-	-	-
4	-	2	-		-	1	-	-	1	-		-	-	-	2
5	-	2	3		-	-	-	1	-	-	1	-	-	-	-
AVg.	2	2.5	3	1.5	-	1	-	1.5	1	-	1		2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

OML352 ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the importance of various materials used in electrical, electronics and
- magnetic applications
- Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
- Gaining knowledge on the selection of suitable materials for the given application
- Knowing the fundamental concepts in Semiconducting materials
- Getting equipped with the materials used in optical and optoelectronic applications.

UNIT- I DIELECTRIC MATERIALS 9

Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT – II MAGNETIC MATERIALS 9

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT – III SEMICONDUCTOR MATERIALS 9

Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT – IV MATERIALS FOR ELECTRICAL APPLICATIONS 9

Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT – V OPTICAL AND OPTOELECTRONIC MATERIALS 9

Principles of photoconductivity - effect of impurities - principles of luminescence-laser principles - He-Ne, injection lasers, LED materials - binary, ternary photoelectronic materials - LCD materials - photo detectors - applications of optoelectronic materials - optical fibres and materials - electro optic modulators - Kerr effect - Pockels effect.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand various types of dielectric materials, their properties in various conditions.

CO2: Evaluate magnetic materials and their behavior.

CO3: Evaluate semiconductor materials and technologies.

CO4: Select suitable materials for electrical engineering applications.

CO5: Identify right material for optical and optoelectronic applications

TEXT BOOKS:

1. Pradeep Fulay, “Electronic, Magnetic and Optical materials”, CRC Press, taylor and Francis, 2 nd illustrated edition, 2017.
2. “R K Rajput”, “A course in Electrical Engineering Materials”, Laxmi Publications, 2009.

REFERENCE BOOKS:

1. T K Basak, “A course in Electrical Engineering Materials”, New Age Science Publications, 2009
2. TTTI Madras, “Electrical Engineering Materials”, McGraw Hill Education, 2004.
3. Adrianus J. Dekker, “Electrical Engineering Materials”, PHI Publication, 2006.
4. S. P. Seth, P. V. Gupta “A course in Electrical Engineering Materials”, Dhanpat Rai & Sons, 2011.
5. C. Kittel, “Introduction to Solid State Physics”, 7th Edition, John Wiley & Sons,Singapore, (2006).

CO’s-PO’s & PSO’s MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	2	2	3								2	2	2	1
C02	3	1	2	2								2	2	2	1
C03	3	2	1	2								2	2	2	1
CO4	3	2	1	2								2	2	2	2
CO5	3	2	2	2								2	2	2	1
Avg	3	1.8	1.6	2.2								2	2	2	1.2

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

OML353 NANOMATERIALS AND APPLICATIONS L T P C

3 0 0 3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
- Gaining knowledge on dimensionality effects on different properties of nanomaterials
- Getting acquainted with the different processing techniques employed for fabricating nanomaterials
- Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
- Acquiring knowledge on different applications of nanomaterials in different disciplines of

engineering.

UNIT I NANOMATERIALS **9**

Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS **9**

Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III PROCESSING **9**

Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV STRUCTURAL CHARACTERISTICS **9**

Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis

UNIT V APPLICATIONS **9**

Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Evaluate nanomaterials and understand the different types of nanomaterials
CO2: Recognise the effects of dimensionality of materials on the properties
CO3: Process different nanomaterials and use them in engineering applications
CO4: Use appropriate techniques for characterising nanomaterials
CO5: Identify and use different nanomaterials for applications in different engineering fields.

TEXT BOOKS:

1. Bhusan, Bharat (Ed), “Springer Handbook of Nanotechnology”, 2nd edition, 2007.
2. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.

REFERENCES:

1. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003
2. Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004
3. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley 2008
4. Wang Z.L., Characterization of Nanophase Materials, Wiley 2000
5. Gutkin Y., Ovid’ko I.A. and Gutkin M., Plastic Deformation in Nanocrystalline Materials, Springer 2004

CO's-PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C01	2	2	2	3								2	1	2	
C02	3	1	2	2								2	2	2	1
C03	3	2	1	2								2	2	2	
CO4	3	1		2								2	2	2	2
CO5	3	2	2	2								2	2	2	1
Avg	2.8	1.6	1.7	2.2								2	1.8	2	1.3

1 - low, 2 - medium, 3 - high, '-' - no correlation

OMR352 HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To knowledge on fluid power principles and working of hydraulic pumps
2. To obtain the knowledge in hydraulic actuators and control components
3. To understand the basics in hydraulic circuits and systems
4. To obtain the knowledge in pneumatic and electro pneumatic systems
5. To apply the concepts to solve the trouble shooting

UNIT – I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT – II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

UNIT – III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT – IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits

UNIT – V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Analyze the methods in fluid power principles and working of hydraulic pumps

CO 2: Recognize the concepts in hydraulic actuators and control components

CO 3: Obtain the knowledge in basics of hydraulic circuits and systems

CO 4: Know about the basics concept in pneumatic and electro pneumatic systems

CO 5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics

CO's-PO's & PSO's MAPPING															
COs/POs & PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1		2	2						1	2	2	1
CO2	3	2	1		2	2						1	2	2	1
CO3	3	2	1		2	2						1	2	2	1
CO4	3	2	1		2	2						1	2	2	1
CO5	3	2	1		2	2						1	2	2	1
CO/PO & PSO Average	3	2	1		2	2						1	2	2	1
1 - low, 2 - medium, 3 - high, '-' - no correlation															

TEXT BOOKS

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997.

REFERENCES

1. Shanmugasundaram.K, "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
2. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance", Tata McG Raw Hill, 2001.
3. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGRaw Hill, 2007.
4. Dudley, A. Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987
5. Srinivasan. R, "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 2008
6. Joshi.P, Pneumatic Control", Wiley India, 2008.
7. Jagadeesha T, "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.

OMR353 SENSORS L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.

2. To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
3. To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
4. To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
5. To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT – I SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES 9

Basics of Measurement – Classification of Errors – Error Analysis – Static and Dynamic Characteristics of Transducers – Performance Measures of Sensors – Classification of Sensors – Sensor Calibration Techniques – Sensor Outputs - Signal Types - Analog and Digital Signals, PWM and PPM.

UNIT – II DISPLACEMENT, PROXIMITY AND RANGING SENSORS 9

Displacement Sensors – Brush Encoders - Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – Range Sensors - Ultrasonic Ranging - Reflective Beacons - Laser Range Sensor (LIDAR) – GPS - RF Beacons.

UNIT – III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gage – Types, Working, Advantage, Limitation, and Applications: Load Measurement – Force and Torque Measurement - Magnetic Sensors – Types, Principle, Advantage, Limitation, and Applications - Magneto Resistive – Hall Effect, Eddy Current Sensor - Heading Sensors – Compass, Gyroscope and Inclinometers.

UNIT – IV OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS 9

Photo Conductive Cell, Photo Voltaic, Photo Resistive, LDR – Fiber Optic Sensors – Pressure – Diaphragm – Bellows - Piezoelectric - Piezo-resistive - Acoustic, Temperature – IC, Thermistor, RTD, Thermocouple – Non Contact Sensor - Chemical Sensors - MEMS Sensors - Smart Sensors.

UNIT – V SIGNAL CONDITIONING 9

Need for Signal Conditioning – Resistive, Inductive and Capacitive Bridges for Measurement - DC and AC Signal Conditioning - Voltage, Current, Power and Instrumentation Amplifiers – Filter and Isolation Circuits – Fundamentals of Data Acquisition System

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the densor response.

CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.

CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.

CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.

CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.

CO's-PO's & PSO's MAPPING															
COs/POs & PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2								1	2	3	2	1
CO2	3	3	2	1	1	1					1	2	3	2	1
CO3	3	3	2	1	1	1					1	2	3	2	1
CO4	3	3	2	1	1	1					1	2	3	2	1
CO5	3	3	2	1	1	1					1	2	3	2	1
CO/PO & PSO Average	3	3	2	0.8	0.8	0.8					0.8	2	3	2	1
1 - low, 2 - medium, 3 - high, '-' - no correlation															

TEXT BOOKS

1. Bolton W., "Mechatronics", Pearson Education, 6th Edition, 2015.
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2013.

REFERENCES

1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., "Mechatronics", Chapman and Hall, 1993.
2. Davis G. Alciatore and Michael B. Histand, "Introduction to Mechatronics and Measurement systems", McGraw Hill Education, 2011.
3. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", Cengage Learning, 2010.
4. Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", McGraw Hill Education, 2015.
5. Smaili. A and Mrad. F, "Mechatronics Integrated Technologies for Intelligent Machines", Oxford University Press, 2007.

ORA352 CONCEPTS IN MOBILE ROBOTS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I INTRODUCTION TO MOBILE ROBOTICS **9**

Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles

UNIT – II KINEMATICS **9**

Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot

Constraints – Degree of Mobility and Steerability – **Manoeuvrability** – Workspace – Degrees of Freedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots

UNIT – III PERCEPTION 9

Sensor for Mobile Robots – Classification and Performance Characterization – Wheel/Motor Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Camera - Visual Appearance based Feature Extraction.

UNIT – IV LOCALIZATION 9

Localization Based Navigation Versus Programmed Solutions - Map Representation - Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization - Landmark-Based Navigation - Globally Unique Localization - Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building - Simultaneous Localization and Mapping (SLAM).

UNIT – V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS 9

Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition - Case Studies – Collaborative Robots – Swarm Robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXTBOOK

1. Roland Siegwart and IllahR.Nourbakish, “Introduction to Autonomous Mobile Robots” MIT Press, Cambridge, 2004.

REFERENCES:

1. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujita, “Humanoid Robots: Modelling and Control”, Butterworth-Heinemann, 2018
2. MohantaJagadish Chandra, “Introduction to Mobile Robots Navigation”, LAP Lambert Academic Publishing, 2015.
3. Peter Corke, “Robotics, Vision and Control”, Springer, 2017.
4. Ulrich Nehmzow, “Mobile Robotics: A Practical Introduction”, Springer, 2003.
5. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, “Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions”, Intec Press, 2009.
6. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University Press, 2013, ISBN: 978-1107031159.

MV3501 **MARINE PROPULSION** **L T P C**
3 0 0 3

COOURSE OBJECTIVES:

1. To impart knowledge on basics of propulsion system and ship dynamic movements
2. To educate them on basic layout and propulsion equipment's
3. To impart basic knowledge on performance of the ship
4. To impart basic knowledge on Ship propeller and its types
5. To impart knowledge on ship rudder and its types

UNIT I BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS 9

law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion , screw propulsion.

UNIT II SHIPS MOVEMENTS AND SHIP STABILIZATION 9

Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

UNIT III SHIPS SPEED AND ITS PERFORMANCE 9

Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation's, ship turning radius.

UNIT IV BASICS OF PROPELLER 9

Propeller dimension, Propeller and its types – fixed propeller, control pitch propeller, kort nozzle, ducted propeller, voith schneider, Parts of propeller, 3 blade - 5 blade - 6 blade propellers and its advantages, propeller boss hub, crown nut, propeller skew, pitch of propeller - Thrust creation by propeller. Propeller Material – Propeller balancing- static and dynamic.

UNIT V BASICS OF RUDDER 9

Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

TEXT BOOKS:

1. GP. Ghose, “Basic Ship propulsion”,2015
2. E.A. Stokoe “Reeds Ship construction for marine engineers”, Vol. 5,2010
3. E.A. Stokoe, “Reeds Naval architecture for the marine engineers”,4th Edition,2009

REFERENCES BOOKS:

1. DJ Eyers and GJ Bruse, “Ship Construction”, 7th Edition, 2006.
2. KJ Rawson and EC Tupper, “Basic Ship theory I” Vol. 1,5th Edition,2001.

CO’s-PO’s & PSO’s MAPPING

CO	PO												PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1	1	1	1	1	1						1	1		1		1
2	1	1	1											1		1
3	1			1	1				1	1	1		1	1		1
4	1		1	1										1		1
5	1		1	1										1		1
Avg	5/5 =1	2/2 =1	4/4 =1	4/4 =1	2/2 =1				1/1 =1	1/1 =1	2/2 =1	1/1 =1	1/1 =1	5/5 =1		5/5 =1

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

OMV351 MARINE MERCHANT VESSELS LT P C
3 0 0 3

COURSE OBJECTIVES:

At the end of the course, students are expected to acquire

1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I INTRODUCTION TO HYDROSTATICS 9

Archimedes Principle- Laws of floatation– Meta centre – stability of floating and submerged bodies- Density, relative density - Displacement –Pressure –centre of pressure.

UNIT II TYPES OF SHIP 10

General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gascarriers - Chemical tankers - Passenger ships

UNIT III SHIPBUILDING MATERIALS 9

Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites

UNIT IV MARINE PROPELLER AND RUDDER 8

Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V GOVERNING BODIES FOR SHIPPING INDUSTRY 9

Role of **IMO** (International Maritime Organization), **SOLAS** (International Convention for the Safety of Life at Sea), **MARPOL** (International Convention for the Prevention of Pollution from Ships) , **MLC** (Maritime Labour Convention), **STCW 2010** (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students would

CO1: Acquire Knowledge on floatation of ships

CO2: Acquire Knowledge on features of various ships

CO3: Acquire Knowledge of Shipbuilding Materials

CO4: Acquire Knowledge to identify the different types of marine propeller and rudder

CO5: Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:

1. D.J.Eyres, “Ship Constructions”, Seventh Edition, Butter Worth Heinemann Publishing, USA,2015
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006
3. EA Stokoe, E.A, “Naval Architecture for Marine Engineers”, Vol.4, Reeds Publications,2000

REFERENCES:

1. Kemp & Young “Ship Construction Sketches & Notes”, Butter Worth Heinemann Publishing,USA, 2011
2. MARPOL Consolidated Edition , Bhandakar Publications, 2018
3. SOLAS Consolidated Edition , Bhandakar Publications, 2016

OMV352 ELEMENTS OF MARINE ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES:

At the end of the course, students are expected to

1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS 9

Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air

compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II MARINE PROPULSION MACHINERY SYSTEM 9

Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM 9

Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV MARINE BOILER SYSTEM 9

Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V SHIP PROPELLERS AND STEERING MECHANISM 9

Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students should able to,

CO1: Distinguish the role of various marine machinery systems

CO2: Relate the components of marine propulsion machinery system

CO3: Explain the importance of marine auxiliary machinery system

CO4: Acquire knowledge of marine boiler system

CO5: Understand the importance of ship propellors and steering system

TEXT BOOKS:

1. Taylor, “Introduction to Marine engineering”, Revised Second Edition, Butterworth Heinemann, London, 2011
2. J.K.Dhar, “Basic Marine Engineering”, Tenth Edition, G-Maritime Publications, Mumbai, 2011
3. K.Ramaraj, “ Text book on Marine Engineering”, Eswar Press, Chennai, 2018

REFERENCES:

1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015

CRA332	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the basics of drone concepts
2. To learn and understand the fundaments of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT – I INTRODUCTION TO DRONE TECHNOLOGY 9

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT – II DRONE DESIGN, FABRICATION AND PROGRAMMING 9

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT – III DRONE FLYING AND OPERATION 9

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications

UNIT – IV DRONE COMMERCIAL APPLICATIONS 9

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT – V FUTURE DRONES AND SAFETY 9

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO5: Createthe programs for various drones

CO's-PO's & PSO's MAPPING

COs/Pos&PSOs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2	3	1	3	2						1	2	1	3
CO2	1	2	3	1	3	2						1	2	1	3
CO3	1	2	3	1	3	2						1	2	1	3
CO4	1	2	3	1	3	2						1	2	1	3
CO5	1	2	3	1	3	2						1	2	1	3
CO/PO & PSO Average	1	2	3	1	3	2						1	2	1	3
1 – Slight, 2 – Moderate, 3 – Substantial															

TEXT BOOKS

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2016

REFERENCES

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

OGI352 GEOGRAPHICAL INFORMATION SYSTEM L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I FUNDAMENTALS OF GIS 9

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

UNIT II SPATIAL DATA MODELS 9

Database Structures – Relational, Object Oriented – Entities – ER diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.

UNIT III DATA INPUT AND TOPOLOGY 9

Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input –

Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration

UNIT IV DATA QUALITY AND STANDARDS 9

Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V DATA MANAGEMENT AND OUTPUT 9

Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS-distributed GIS.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to

CO1 Have basic idea about the fundamentals of GIS.
CO2 Understand the types of data models.
CO3 Get knowledge about data input and topology
CO4 Gain knowledge on data quality and standards
CO5 Understand data management functions and data output

TEXTBOOKS:

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

REFERENCES:

1. Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

CO’s-PO’s & PSO’s MAPPING: GEOGRAPHICAL INFORMATION SYSTEM

PO	Graduate Attribute	Course Outcome					Average
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering Knowledge	3	3	3	3	3	3
PO2	Problem Analysis				3	3	3
PO3	Design/Development of Solutions			3	3	3	3
PO4	Conduct Investigations of Complex Problems			3	3	3	3
PO5	Modern Tool Usage		3		3	3	3
PO6	The Engineer and Society						
PO 7	Environment and Sustainability						
PO 8	Ethics						
PO 9	Individual and Team Work						
PO 10	Communication						
PO 11	Project Management and Finance						
PO 12	Life-long Learning						

PSO 1	Knowledge of Geoinformatics discipline	3	3	3	3	3	3
PSO 2	Critical analysis of Geoinformatics Engineering problems and innovations	3	3	3	3	3	3
PSO 3	Conceptualization and evaluation of Design solutions	3	3	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

OAI352 AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT 9

Entrepreneur Development(ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics-Entrepreneurship development programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE 9

Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)-Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).

UNIT III ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE 9

Entrepreneurship - Essence of managerial Knowledge -Management functions- Planning-organizing-Directing-Motivation-ordering-leading-supervision- communication and control-Understanding Financial Aspects of Business - Importance of financial statements-liquidity ratios-leverage ratios, coverage ratios-turnover ratios-Profitability ratios. Agro-based industries-Project-Project cycle-Project appraisal and evaluation techniques-undiscounted measures-Payback period-proceeds per rupee of outlay, Discounted measures-Net Present Value (NPV)-Benefit-Cost Ratio(BCR)-Internal Rate of Return(IRR)-Net benefit investment ratio(N/K ratio)-sensitivity analysis.

UNIT IV ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE 9

Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs-Economic system and its implication for decision making by individual entrepreneurs.

UNITV ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT **9**

Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private
partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Judge about agricultural finance, banking and cooperation
CO2: Evaluate basic concepts, principles and functions of financial management
CO3: Improve the skills on basic banking and insurance schemes available to customers
CO4: Analyze various financial data for efficient farm management
CO5: Identify the financial institutions

TEXT BOOKS

1. Joseph L. Massie, 1995, “Essentials of Management”, prentice Hall of India Pvt limited, New Delhi
2. Khanka S, 1999, Entrepreneurial Development, S, Chand and Co, New Delhi
3. Mohanty S K, 2007, Fundamentals of Entrepreneurship, Prentice Hall India, New Delhi.

REFERENCES

1. Harih S B, Conner U J and Schwab G D, 1981, Management of the Farm Business, Prentice Hall Inc, New Jersey
2. Omri Ralins, N.1980, Introduction to Agricultural: Prentice Hall Inc, New Jersey
3. Gittenger Price, 1989, Economic Analysis of Agricultural project, John Hopkins University, Press, London.
4. Thomas W Zimmer and Norman M Scarborough, 1996, Entrepreneurship, Prentice Hall, New Jersey.
5. Mar J Dollinger, 1999, Entrepreneurship strategies and resources, Prentice –Hall, Upper Saddal Rover, New Jersey.

CO’s-PO’s & PSO’s MAPPING

PO/PSO		CO1	CO2	CO3	CO4	CO5	Overall correlation of COs with POs
PO1	Engineering Knowledge	1	2	1	1	1	2
PO2	Problem Analysis	2	1	1	1	2	1
PO3	Design/ Development of Solutions	1	1	1	2	1	2
PO4	Conduct Investigations of Complex Problems	1	1	2	1	1	1
PO5	Modern Tool Usage	2	1	1	1	1	2
PO6	The Engineer and Society	1	2	1	2	1	1
PO7	Environment and sustainability	1	1	2	1	1	1
PO8	Ethics	1	2	1	1	1	1
PO9	Individual and team work:	1	1	1	2	1	1
PO10	Communication	1	1	1	1	2	1

PO11	Project management and finance	1	1	2	1	1	1
PO12	Life-long learning:	1	2	1	1	1	2
PSO1	To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill	1	2	1	1	1	1
PSO2	To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.	1	1	2	1	1	1
PSO3	To inculcate entrepreneurial skills through strong Industry-Institution linkage.	1	2	1	1	2	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

OEN352 BIODIVERSITY CONSERVATION L T P C

3 0 0 3

COURSE OBJECTIVE:

The identification of different aspects of biological diversity and conservation techniques.

UNIT I INTRODUCTION 9

Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

UNIT II INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY 9

Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

UNIT III MICROBIAL DIVERSITY 9

Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis

UNIT IV MEGA DIVERSITY 9

Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio- economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

UNIT V CONSERVATIONS OF BIODIVERSITY 9

In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ

conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species

TOTAL: 45 PERIODS

TEXT BOOKS:

1. A textbook of Botany: Angiosperms- Taxonomy, Anatomy, Economic Botany & Embryology. S. Chand, Limited, Pandey, B. P. January 2001
2. Principles of Systematic Zoology, Mcgraw-Hill College, Ashlock, P.D., Latest Edition.
3. Microbiology, MacGraw Hill Companies Inc, Prescott, L.M., Harley, J.P., and Klein D.A. (2022).
4. Microbiology, Pearson Publisher, Gerard J. Tortora, Berdell R. Funke, Christine L.Case, 13th Edition 2019

REFERENCES:

1. Ecological Census Technique: A Handbook, Cambridge University Press, Sutherland, W.
2. Encyclopedia of Biodiversity, Academic Press, Simonson Asher Levin.

COURSE OUTCOMES

Upon successful completion of this course, students will:

CO1: An insight into the structure and function of diversity for ecosystem stability.

CO2: Understand the concept of animal diversity and taxonomy

CO3: Understand socio-economic issues pertaining to biodiversity

CO4: An understanding of biodiversity in community resource management.

CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.

CO's- PO's & PSO's MAPPING

	PO's												PSO's		
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1		2						2		2			2	2	
2		2		2	2	2							3	2	
3				2		2							3	2	3
4	3	2			2			2	2	2	2		3	2	3
5		2	3	2			1					1		2	
Avg.	3	2	3	2	2	2	1	2	2	2	2	1	3	2	3

1.low, 2-medium, 3-high, '-"- no correlation

Note: The average value of this course to be used for program articulation matrix.

OEE353 INTRODUCTION TO CONTROL SYSTEMS L T P C

3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems
- To analyze the stability of linear systems in frequency domain and time domain
- To develop linear models mainly state variable model and transfer function model

UNIT I MATHEMATICAL MODELS OF PHYSICALSYSTEMS 9

Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS & ROOTLOCUSTECHNIQUE 9

Standard test signals – Steady state error & error constants – Time Response of I and II order system–Root locus–Rules for sketching root loci.

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS 9

Concept of stability – Necessary condition – RH criterion – Relative stability – Nyquist stability criterion — Stability from Bode plot — Relative stability from Nyquist & Bode — Closed loop frequency response.

UNITV STATE VARIABLE ANALYSIS 9

Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Ability to

CO1: Design the basic mathematical model of physical System.
CO2: Analyze the time response analysis and techniques.
CO3: Analyze the transfer function from different plots.
CO4: Apply the stability concept in various criterion.
CO5: Assess the state models for linear and continuous Systems.

TEXTBOOKS

1. Farid Golnarghi **,** Benjamin C. Kuo, Automatic Control Systems Paper back McGraw Hill Education, 2018.
2. Katsuhiko Ogata, 'Modern Control Engineering', Pearson, 5th Edition2015.
3. J. Nagrath and M. Gopal, Control Systems Engineering (Multi Colour Edition), New Age International, 2018.

REFERENCES

1. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 2010.
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.
3. John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, Linear Control System AnalysisandDesign, 5th Edition, CRC PRESS, 2003.
4. S. Palani, Control System Engineering, McGraw-Hill Education Private Limited, 2009.
5. Yaduvir Singh and S.Janardhanan, Modern Control, Cengage Learning, First Impression2010.

CO's-PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2							2	3	3	3
CO2	3	3	2	3	1								3	3	3
CO3	3	3	3	2	2								3	3	3
CO4	3	3	3	2	2							2	3	3	3
CO5	3	3	3	1	1							1	3	3	3
													3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

OEI354 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS LT P C
3 0 03

COURSE OBJECTIVES:

1. To educate on design of signal conditioning circuits for various applications.
2. To Introduce signal transmission techniques and their design.
3. Study of components used in data acquisition systems interface techniques
4. To educate on the components used in distributed control systems
5. To introduce the communication buses used in automation industries.

UNIT I INTRODUCTION 9

Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems : Modbus & Profibus

UNIT II AUTOMATION COMPONENTS 9

Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS 9

Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 9

Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V DISTRIBUTED CONTROL SYSTEM 9

Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)
4. Market survey of Industrial Data Networks.

COURSE OUTCOMES:

Students able to

CO1 Design a signal conditioning circuits for various application (L3).

CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).

CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).

CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function BIock.(L3)

CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:

1. S.K.Singh, “Industrial Instrumentation”, Tata Mcgraw Hill, 2nd edition companies,2003.
2. C D Johnson, “Process Control Instrumentation Technology”, Prentice Hall India,8th Edition, 2006.
3. E.A.Parr, Newnes ,NewDelhi,“Industrial Control Handbook”,3rd Edition, 2000.

REFERENCES:

1. John W. Webb and Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications”, 5th Edition, Prentice Hall Inc., New Jersey, 2003.
2. Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw- Hill, New York, 2016.
3. Krishna Kant, “Computer - Based Industrial Control”, 2nd Edition, Prentice Hall, New Delhi, 2011.
4. Gary Dunning, Thomson Delmar,“Programmable Logic Controller”, CeneageLearning, 3 rd Edition,2005.

List of Open Source Software/ Learning website:

1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063
3. https://www.electrical4u.com/industrial-automation/
4. https://realpars.com/what-is-industrial-automation/
5. https://automationforum.co/what-is-industrial-automation-2/

CO’s- PO’s & PSO’s MAPPING

	PO’s												PSO’s		
CO’s	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	1	1	-	1	-	1	-	1	1	-	1
CO2	3	`1	1	-	1	-	-	1	-	1	-	-	1	-	1
CO3	3	-	1	-	1	-	-	1	-	1	-	-	1	-	1
CO4	3	3	3	3	1			1		1			1		1
CO5	3	3	3	3	1	1		1		1			1		1

AVg.	3	2.25	2	2.6	1	1	-	1	-	1	-	-	1	-	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

OCH353 ENERGY TECHNOLOGY L T P C
3 0 0 3

UNIT I INTRODUCTION 8

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II CONVENTIONAL ENERGY 8

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY 10

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY 10

Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V ENERGY CONSERVATION 9

Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.

CO2: Students will excel as professionals in the various fields of energy engineering

CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.

CO4: Explain the technological basis for harnessing renewable energy sources.

CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.
4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCES

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.

CO's-PO's & PSO's MAPPING

Course Outcomes	Program Outcomes														
	Statements	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.	**2**	**3**	**2**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**3**	**1**	**1**	**3**
CO2	Students will excel as professionals in the various fields of energy engineering	**2**	**3**	**1**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**3**	**2**	**1**	**3**
CO3	Compare different renewable energy technologies and choose the most appropriate based on local conditions.	**2**	**2**	**2**	**3**	**3**	**1**	**1**	**-**	**1**	**1**	**-**	**3**	**2**	**1**	**3**
CO4	Explain the technological basis for harnessing renewable energy sources.	**2**	**2**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**-**	**1**	**3**	**1**	**1**	**3**
CO5	Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level	**2**	**2**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**-**	**1**	**3**	**2**	**1**	**3**
OVERALL CO		**2**	**2**	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**2**	**1**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OCH354	SURFACE SCIENCE	L T P C
		3 0 0 3

COURSE OBJECTIVE:

- To enable the students to analyze properties of a surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES 9

Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES 9

Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES 9

Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS 9

Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fishcher-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES 9

Origin of surface forces, Role of stress and strain in epitaxial growth, Energetic and growth modes, Nucleation theory, Nonequilibrium growth modes, MBE, CVD and ablation techniques, Catalytic growth of nanotubes, Etching of surfaces, Formation of nanopillars and nanorods and its application in photoelectrochemical processes, Polymer surfaces and biointerfaces.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena

TEXT BOOK:

1. K. W. Kolasinski, "Surface Science: Foundations of catalysis and nanoscience" II Edition, John

Wiley & Sons, New York, 2008.

REFERENCE:

1. Gabor A. Somorjai and Yimin Li "Introduction to Surface Chemistry and catalysis", II Edition John Wiley & Sons, New York, 2010.

OFD354 FUNDAMENTALS OF FOOD ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES

The course aims to

- acquaint and equip the students with different techniques of measurement of engineering properties.
- make the students understand the nature of food constituents in the design of processing equipment

UNIT I **9**

Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

UNIT II **9**

Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers

UNIT III **9**

Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

UNIT IV **9**

Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for lo.w- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.

UNIT V **9**

Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing

variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 understand the importance of food polymers

CO2 understand the effect of various methods of processing on the structure and texture of food materials

CO3 understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.

TEXTBOOKS:

1. R.L. Earle. 2004. Unit Operations in Food Processing. The New Zealand Intitute of Food Science & Technology, Nz. Warren L. McCabe, Julian Smith, Peter Harriott. 2004.
2. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA. Christie John Geankoplis. 2003.
3. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.
4. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
5. J. F. Richardson, J. H. Harker and J. R. Backhurst. 2002. Coulson & Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes, 5th Ed.

OFD355 FOOD SAFETY AND QUALITY REGULATION L T P C

3 0 0 3

COURSE OBJECTIVES:

• To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments

• To help become skilled in systems for food safety surveillance

• To be aware of the regulatory and statutory bodies in India and the world

• To ensure processed food meets global standards

UNIT I **10**

Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II **8**

Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III **9**

Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food

inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV **9**

Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V **9**

Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments

CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:

1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
3. Nutritional and safety aspects of food processing by Tannenbaum SR, Marcel Dekker Inc., New York 1979
4. Microbiological safety of Food by Hobbs BC, 1973
5. Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003

OPY353 **NUTRACEUTICALS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I INTRODUCTION AND SIGNIFICANCE **6**

Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS **11**

Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, caratenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.

UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY **11**

In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different *in*

vitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV ROLE IN HEALTH AND DISEASE 11

The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V SAFETY ISSUES 6

Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bisset, Normal Grainger and Max Wich H “Herbal Drugs and Phytopharmaceuticals”, 2nd Edition, CRC, 2001.
2. Handbook of Nutraceuticals and Functional Foods: Robert Wildman, CRC, Publications. 2006
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006
4. Ikan, Raphael “Natural Products: A Laboratory Guide”, 2nd Edition, Academic Press / Elsevier, 2005.

REFERENCES:

1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007
2. Functional Foods and Nutraceuticals in Cancer Prevention by Ronald Ross Watson (Author), Blackwell Publishing, 2007
3. Marketing Nutrition: Soy, Functional Foods, Biotechnology, and Obesity by Brian Wansink.
4. Functional foods: Concept to Product: Edited by G R Gibson and C M Williams, Wood head Publ., 2000
5. Hanson, James R. “Natural Products: The Secondary Metabolites”, Royal Society of Chemistry, 2003.

COURSE OUTCOME - NUTRACEUTICALS

CO 1	acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits.
CO 2	acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes
CO 3	attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.
CO 4	distinguish the various *In vitro* and *In vivo* assessment of Antioxidant activity of compounds from plant sources.
CO 5	gain information about the health benefits of various functional foods and nutraceuticals

	in the prevention and treatment of various lifestyle diseases.
CO 6	Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level.

CO's-PO's & PSO's MAPPING												
NUTRACEUTICALS												
Course outcome	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO8	PO 9	PO10	PO11	PO12
CO 1	3											1
CO 2	3											1
CO 3	3					2						
CO 4	3											
CO 5	3					2						1
CO 6	3							2				1

1 - low, 2 - medium, 3 - high, '-' - no correlation

OTT354 BASICS OF DYEING AND PRINTING L T P C
3 0 0 3

COURSE OBJECTIVE:

- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

UNIT I INTRODUCTION 9

Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,

UNIT II PRE TREATMENT 9

Desizing-Objective of Desizing- types of Desizing- Objective of Scouring- Mechanism of Scouring– Degumming of Silk, Scouring of wool - Bio Scouring. Bleaching -Objective of Bleaching: Bleaching mechanism of Hydrogen Peroxide, Hypo chlorites. Objective of Mercerizing - Physical and Chemical changes of Mercerizing.

UNIT III DYEING 9

Dye - Affinity, Substantively, Reactivity, Exhaustion and Fixation. Classification of dyes. Direct dyes: General properties, principles and method of application on cellulosic materials. Reactive dyes – principles and method of application on cellulosic materials hot brand, cold brand.

UNIT IV PRINTING 9

Definition of printing – Difference between printing and dying- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.

UNIT V MACHINERIES 9

Fabric Processing - winch, jigger and soft flow machines. Beam dyeing machines: Printing -flat bed screen - Rotary screen. Thermo transfer printing machinery. Garment dyeing machines.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to Understand the

CO1: Basics of grey fabric
CO2: Basics of pre treatment
CO3: Concept of Dyeing
CO4: Concept of Printing
CO5: Machinery in processing industry

TEXT BOOKS:

1. Trotman, E.R., Textile Scouring and Bleaching, Charless Griffins, Com. Ltd., London 1990.
2. Shenai V.A. “Technology of Textile Processing Vol. IV” 1998, Sevak Publications, Mumbai.

REFERENCES:

1. Trotman E. R., “Dyeing and Chemical Technology of Textile Fibres”, Charles Griffin & Co. Ltd., U.K., 1984, ISBN : 0 85264 165 6.
2. Dr. N N Mahapatra., “Textile dyeing”, Wood head publishing India, 2018
3. Mathews Kolanjikombil., ”Dyeing of Textile substrates III –Fibres, Yarns and Knitted fabrics”, Wood head publishing India , 2021
4. Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series
5. Chakraborty, J.N, "Fundamentals and Practices in colouration of Textiles", Wood head Publishing India, 2009, ISBN-13:978-81-908001-4-3.

CO’s-PO’s & PSO’s MAPPING

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Course Outcomes	Program Outcome															
	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Classification of fibres and production of natural fibres	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO2	Regenerated and synthetic fibres	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO3	Yarn spinning	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO4	Weaving	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
CO5	Knitting and nonwoven	-	-	-	-	-	-	-	2	1	-	1	1	-	1	-
Overall CO		-	-	-	-	-	-	-	2	1	-	1	1	-	1	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

FT3201 FIBRE SCIENCE L T P C
3 0 0 3

COURSE OBJECTIVES

- To enable the students to learn about the types of fibre and its properties

UNIT I INTRODUCTION TO TEXTILE FIBRES 9

Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool -Physical and chemical structure of the above fibres.

UNIT II REGENERATED FIBRES 9

Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel ,Tencel

UNIT III SYNTHEITC FIBRES 9

Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass ,carbon .Introduction to spin finishes and texturization

UNIT IV SPECIALITY FIBRES 9

Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres

UNIT V FUNCTIONAL SPECIALITY FIBRES 9

Properties and end uses : Fibres for medical application – Biodegradable fibres based on PLA ,Super absorbent fibres elastomeric fibres, ultra-fine fibres, electrospun nano fibres, metallic fibres – Gold and Silver coated.

TOTAL : 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the student would be able to

CO1: Understand the process sequence of various fibres

CO2: Understand the properties of various fibres

TEXT BOOKS:

1. Morton W. E., and Hearle J. W. S., “Physical Properties of Textile Fibres”, The Textile Institute, Washington D.C., 2008, ISBN 978-1-84569-220-95
2. Meredith R., and Hearle J. W. S., “Physical Methods of Investigation of Textiles”, Wiley Publication, New York, 1989, ISBN: B00JCV6ZWU | ISBN-13:
3. Mukhopadhyay S. K., “Advances in Fibre Science”, The Textile Institute,1992, ISBN: 1870812379

REFERENCES:

1. Meredith R., “Mechanical Properties of Textile Fibres”, North Holland, Amsterdam, 1986, ISBN: 1114790699, ISBN-13: 9781114790698
2. Hearle J. W. S., Lomas B., and Cooke W. D., “Atlas of Fibre Fracture and Damage to Textiles”, The Textile Institute, 2nd Edition, 1998, ISBN: 1855733196.

3. Raheel M. (ed.)., “Modern Textile Characterization Methods”, Marcel Dekker, 1995, ISBN:0824794737
4. Mukhopadhyay. S. K., “The Structure and Properties of Typical Melt Spun Fibres”, Textile Progress, Vol. 18, No. 4, Textile Institute, 1989, ISBN: 1870812115
5. Hearle J.W.S., “Polymers and Their Properties: Fundamentals of Structures and Mechanics Vol 1”, Ellis Horwood, England, 1982, ISBN: 047027302X | ISBN-13: 9780470273029 36

OTT355 GARMENT MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVE:

- To enable the students to understand the basics of pattern making, cutting and sewing.
- To expose the students to various problems & remedies during garment manufacturing

UNIT I PATTERN MAKING, MARKER PLANNING, CUTTING 9

Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES 9

Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint

UNIT III COMPONENTS AND TRIMS USED IN GARMENT 9

Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons

UNIT IV GARMENT INSPECTION AND DIMENSIONAL CHANGES 9

Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V GARMENT PRESSING, PACKING AND CARE LABELING 9

Garment pressing – categories and equipment, packing; care 336abelling of apparels

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to Understand
CO1: Pattern making, marker planning, cutting
CO2: Types of seams, stitches and functions of needles
CO3: Components and trims used in garment
CO4: Garment inspection and dimensional changes
CO5: Garment pressing, packing and careabelling

TEXT BOOKS:

1. Carr H., and Latham B., “The Technology of Clothing Manufacture”, Blackwell Science Ltd., Oxford, 1994.
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64

3. Harrison.P.W Garment Dyeing, The Textile Institute Publication, Textile Progress, Vol .19 No.2,1988.

REFERENCES:

1. Winifred Aldrich., “Metric Pattern Cutting”, Blackwell Science Ltd., Oxford, 1994
2. Peggal H., “The Complete Dress Maker”, Marshall Caverdish, London, 1985
3. Jai Prakash and Gaur R.K., “Sewing Thread”, NITRA, 1994
4. Ruth Glock, Grace I. Kunz, “Apparel Manufacturing”, Dorling Kindersley Publishing Inc., New Jersey, 1995.
5. Pradip V.Mehta, “An Introduction to Quality Control for the Apparel Industry”, J.S.N. Internationals, 1992.

CO’s-PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	1	-	2	-	1	1	-	2	3	1	2	3	1	3
2	2	2	1	1	1	-	1	1	-	2	2	1	2	2	1	2
3	1	1	1	1	1	1	1	1	-	1	2	1	1	3	1	3
4	2	1	1	1	2	2	2	1	1	2	3	1	2	3	1	3
5	2	2	1	1	1	1	2	1	-	2	2	1	2	2	1	2
Avg	1.6	1.2	1	0.8	1.4	0.8	1.4	1	0.2	1.8	2.4	1	1.8	2.6	1	2.6

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

OPE353 INDUSTRIAL SAFETY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION 9

Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE 9

Definition of the term occupational health and hygiene - Categories of health hazards - Exposure pathways and human responses to hazardous and toxic substances - Advantages and limitations of environmental monitoring and occupational exposure limits - Hierarchy of control measures for occupational health risks - Role of personal protective equipment and the selection criteria - Effects on humans - control methods and reduction strategies for noise, radiation and excessive stress.

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS 9

Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and colour, Ventilation and Heat Control – Electrical Safety – Fire Safety – Safe Systems of work for manual handling operations – Machine guarding – Working at different levels – Process and System Safety.

UNIT IV HAZARDS AND RISK MANAGEMENT 9

Safety appraisal - analysis and control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques – major accident hazard control – Onsite and Offsite emergency Plans.

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT 9

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and methods of its effective implementation and review – Elements of Management Principles – Education and Training – Employee Participation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the student is expected to be able to:

CO1: Describe, with example, the common work-related diseases and accidents in occupational setting

CO2: Name essential members of the Occupational Health team

CO3: What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354 UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES L T P C

3 0 0 3

COURSE OBJECTIVES:

- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I FLUID MECHANICS CONCEPTS 9

Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton's Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler's equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II FLOW MEASUREMENTS & MECHANICAL OPERATIONS 9

Different types of flow measuring devices (Orifice meter, Venturimeter, Rotameter) with derivations, flow measurements –. Pumps – types of pumps (Centrifugal & Reciprocating pumps), Energy calculations and characteristics of pumps. Size reduction–characteristics of comminute products, sieve analysis, Properties and handling of particulate solids – characterization of solid particles, average particle size, screen analysis- Conceptual numerical of differential and

cumulative analysis. Size reduction, crushing laws, working principle of ball mill. Filtration & types, filtration equipments (plate and frame, rotary drum). Conceptual numericals.

UNIT III CONDUCTIVE & CONVECTIVE HEAT TRANSFER 9

Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV BASICS OF MASS TRANSFER 9

Diffusion-Fick's law of diffusion. Types of diffusion. Steady state molecular diffusion in fluids at rest and laminar flow (stagnant / unidirection and bi direction). Measurement of diffusivity, Mass transfer coefficients and their correlations. Conceptual numerical.

UNIT V MASS TRANSFER OPERATIONS 9

Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction).Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method.Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1: State and describe the nature and properties of the fluids.

CO2: Study the different flow measuring instruments, the principles of various size reductions, conveying equipment's, sedimentation and mixing tanks.

CO3: Comprehend the laws governing the heat and mass transfer operations to solve the problems.

CO4: Design the heat transfer equipment suitable for specific requirement.

TEXTBOOK(S)

1. Unit operations in Chemical Engineering Warren L. McCabe, Julian C. Smith & Peter Harriot McGraw-Hill Education (India) Edition 2014
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008
3. Introduction to Chemical Engineering Badger W.I. and Banchero, J.T., Tata McGraw Hill New York 1997

REFERENCE BOOKS

1. Principles of Unit Operations Alan S Foust, L.A. Wenzel, C.W. Clump, L. Maus, and L.B. Anderson John Wiley & Sons 2nd edition 2008
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996
3. Heat Transfer J P Holman McGraw Hill International Ed

OPT352 PLASTIC MATERIALS FOR ENGINEERS L T P C
3 0 0 3

COURSE OBJECTIVES

- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I INTRODUCTION TO PLASTIC MATERIALS 9

Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II ENGINEERING THERMOPLASTICS AND APPLICATIONS 9

Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)

UNIT III THERMOSETTING PLASTICS 9

Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV MISCELLANEOUS PLASTICS FOR END APPLICATIONS 9

Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers-their synthesis, properties and applications

UNIT V PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS 9

Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: To study the importance, advantages and classification of plastic materials

CO2: Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics

CO3: To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins

CO4: Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU

CO5: To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES

1. Marianne Gilbert (Ed.), Brydson's Plastics Materials, 8th Edn., Elsevier (2017).
2. J.A.Brydson, Plastics Materials, 7th Edn., Butterworth Heinemann (1999).
3. Manas Chanda, Salil K. Roy, Plastics Technology Handbook, 4th Edn., CRC press (2006).
4. A. Brent Strong, Plastics: Materials and Processing, 3rd Edn., Pearson Prentice Hall (2006).
5. Olagoke Olabisi, Kolapo Adewale (Eds.), Handbook of Thermoplastics 2nd Edn., CRC press(2016).
6. Charles A. Harper, Modern Plastics Handbook, McGraw-Hill, New York, 1999.
7. H. Dominighaus, Plastics for Engineers, Hanser Publishers, Munich, 1988.

OPT353 PROPERTIES AND TESTING OF PLASTICS L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

UNIT I INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS 9

Introduction- Standard organizations: BIS, ASTM, ISO, BS, DIN etc. Standards and specifications. Importance of standards in the quality control of polymers and polymer products. Preparation of test pieces, conditioning and test atmospheres. Tests on elastomers: processability parameters of rubbers – plasticity, Mooney viscosity, scorch time, cure time, cure rate index, Processability tests carried out on thermoplastics and thermosets: MFI, cup flow index, gel time, bulk density, bulk factor.

UNIT II MECHANICAL PROPERTIES 9

Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers

UNIT III THERMAL RHEOLOGICAL PROPERTIES 9

Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

UNIT IV ELECTRICAL AND OPTICAL PROPERTIES 9

Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence**.**

UNIT V ENVIRONMENTAL AND CHEMICAL RESISTANCE 9

Environmental stress crack resistance (ESCR), water absorption, weathering, aging, ozone resistance, permeability and adhesion. Tests for chemical resistance. Acids, alkalies, Flammability tests- oxygen index test.

TOTAL : 45 PERIODS

COURSE OUTCOMES

- Understand the relevance of standards and specifications.
- Summarize the various test methods for evaluating the mechanical properties of the polymers.
- To know the thermal, electrical & optical properties of polymers.
- Identify various techniques used for characterizing polymers.
- Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES

1. F.Majewska, H.Zowall, Handbook of analysis of synthetic polymers and plastics, Ellis Horwood Limited Publisher 1977.
2. J.F.Rabek, Experimental Methods in Polymer Chemistry, John Wiley and Sons 1980.
3. R.P.Brown, Plastic test methods, 2nd Edn., Harlond, Longman Scientific, 1981.
4. A. B. Mathur, I. S. Bharadwaj, Testing and Evaluation of Plastcis, Allied Publishers Pvt. Ltd., New Delhi, 2003.
5. Vishu Shah, Handbook of Plastic Testing Technology, 3rd Edn., John Wiley & Sons 2007.
6. S. K. Nayak, S. N. Yadav, S. Mohanty, Fundamentals of Plastic Testing, Springer, 2010.

OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES

- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

UNIT I OVERVIEW OF IWRM 9

Facts about water - Definition – Key challenges - Paradigm shift - Water management Principles - Social equity - Ecological sustainability – Economic efficiency - SDGs - World Water Forums.

UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION 9

Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.

UNIT III WATER ECONOMICS 9

Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

UNIT IV RECENT TREANDS IN WATER MANAGEMENT 9

River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.

UNIT V IMPLEMENTATION OF IWRM 9

Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On completion of the course, the student will be able to apply appropriate management techniques towards managing the water resources.

CO1 Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.

CO2 Discuss on the different water uses; how it is impacted and ways to tackle these impacts.

CO3 Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.

CO4 Illustrate the recent trends in water management.

CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS

1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2. Mollinga P. *et al.* " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.

REFERENCES

1. Technical Advisory Committee, Background Papers No: 1, 4 and 7, Stockholm, Sweden. 2002.
2. IWRM Guidelines at River Basin Level (UNESCO, 2008).
3. Tutorial on Basic Principles of Integrated Water Resources Management ,CAP-NET. http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/introduction%20to%20iwrm/Tutorial_text.pdf
4. Pramod R. Bhave, 2011, Water Resources Systems, Narosa Publishers.
5. The 17 Goals, United Nations, https://sdgs.un.org/goals.

OEC353 VLSI DESIGN L T P C

3 0 0 3

COURSE OBJECTIVES:

- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.
- Understand Interconnects and Memory Architecture.

- Understand the design of arithmetic building blocks

UNIT I MOS TRANSISTOR PRINCIPLES **9**

MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics ,small signal analysis of MOSFET.

UNIT II COMBINATIONAL LOGIC CIRCUITS **9**

Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation.

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES **9**

Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design .

UNIT IV INTERCONNECT, MEMORY ARCHITECTURE **9**

Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.

UNIT V DESIGN OF ARITHMETIC BUILDING BLOCKS **9**

Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course the student will be able to

CO1: Understand the working principle and characteristics of MOSFET
CO2: Design Combinational Logic Circuits
CO3: Design Sequential Logic Circuits and Clocking systems
CO4: Understand Memory architecture and interconnects
CO5: Design of arithmetic building blocks.

TEXTBOOKS

1. Jan D Rabaey, Anantha Chandrakasan, "Digital Integrated Circuits: A Design Perspective", PHI, 2016.(Units II, III IV and V).
2. Neil H E Weste, Kamran Eshranghian, "Principles of CMOS VLSI Design: A System Perspective," Addison Wesley, 2009.(Units - I).

REFERENCES

1. D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983
2. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers,2001
3. Samiha Mourad and Yervant Zorian, "Principles of Testing Electronic Systems", Wiley 2000
4. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers,2000

CO's-PO's & PSO's MAPPING

C	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO
1	3	3	2	2	1	3	-	-	-	-	2	3	3	3	3
2	3	3	2	2	1	-	-	-	-	-	-	2	3	3	3
3	3	-	3	2	1	2	-	-	-	-	3	2	3	2	3
4	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
5	2	-	3	2	2	1	-	-	-	-	1	1	3	2	2
C	**3**	**3**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

OBT355 BIOTECHNOLOGY FOR WASTE MANAGEMENT L T P C
3 0 0 3

UNIT I BIOLOGICAL TREATMENT PROCESS 9

Fundamentals of biological process - Anaerobic process – Pretreatment methods in anaerobic process – Aerobic process, Anoxic process, Aerobic and anaerobic digestion of organic wastes - Factors affecting process efficiency - Solid state fermentation – Submerged fermentation – Batch and continous fermentation

UNIT II WASTE BIOMASS AND ITS VALUE ADDITION 9

Types of waste biomass – Solid waste management - Nature of biomass feedstock – Biobased economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application

UNIT III BIOCONVERSION OF WASTES TO ENERGY 9

Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production - Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

UNIT IV CHEMICALS AND ENZYME PRODUCTION FROM WASTES 9

Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases

UNIT V BIOCOMPOSTING OF ORGANIC WASTES 9

Overview of composting process - Benefitis of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students should be able

CO1: To learn the various methods biological treatment

CO2: To know the details of waste biomass and its value addition

CO3: To develop the bioconversion processes to convert wastes to energy

CO4: To synthesize the chemicals and enzyme from wastes

CO5: To produce the biocompost from wastes
CO6: To apply the theoretical knowledge for the development of value added products

TEXT BOOKS

1. Antoine P. T., (2017) "Biofuels from Food Waste Applications of Saccharification Using Fungal Solid State Fermentation", CRC press
2. Joseph C A., (2019)"Anaerobic Waste-Wastewater Treatment and Biogas Plants-A Practical Handbook", CRC Press,

REFERENCE BOOKS

1. Palmiro P. and Oscar F.D'Urso, (2016) 'Biotransformation of Agricultural Waste and By-Products',The Food, Feed, Fibre, Fuel (4F) Economy, Elsevier
2. Kaur Brar S., Gurpreet Singh D. and Carlos R.S., (Eds), (2014)'Biotransformation of Waste Biomass into High Value Biochemicals', Springer.
3. Keikhosro K, Editor, (2015) 'Lignocellulose-Based Bioproducts', Springer.
4. John P, (2014) 'Waste Management Practices-Municipal, Hazardous, and Industrial', Second Edition, CRC Press, 2014

OBT356 LIFESTYLE DISEASES L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.

UNIT II CANCER 9

Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment

UNIT III CARDIOVASCULAR DISEASES 9

Coronoary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse -– Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV DIABETES AND OBESITY 9

Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V RESPIRATORY DISEASES 9

Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.Kumar&Meenal Kumar, "Guide to Prevention of Lifestyle Diseases", Deep & Deep Publications, 2003
2. Gary Eggar et al, "Lifestyle Medicine", 3rd Edition, Academic Press, 2017

REFERENCES:

1. James M.R, “Lifestyle Medicine”, 2nd Edition, CRC Press, 2013
2. Akira Miyazaki et al, “New Frontiers in Lifestyle-Related Disease”, Springer, 2008

OBT357 BIOTECHNOLOGY IN HEALTH CARE L T P C
3 0 0 3

COURSE OBJECTIVES

The aim of this course is to

1. Create higher standard of knowledge on healthcare system and services
2. Prioritize advanced technologies for the diagnosis and treatment of various diseases

UNIT I PUBLIC HEALTH 9

Definition and Concept of Public Health, Historical aspects of Public Health, Changing Concepts of Public Health, Public Health versus Medical Care, Unique Features of Public Health, Determinants of Health (Social, Economic, Cultural, Environmental, Education, Genetics, Food and Nutrition). Indicators of health, Burden of disease, Role of different disciplines in Public Health.

UNIT II CLINICAL DISEASES 9

Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer

UNIT III VACCINOLOGY 9

History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.

UNIT IV OUTPATIENT & IN PATIENT SERVICES 9

Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.

UNIT V BASICS OF IMAGING MODALITIES 9

Diagnostic X-rays - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.
2. Thomas M. Devlin.Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers
3. The Vaccine Book (2nd Ed.), Rafi Ahmed, Roy M. Anderson et. al.Editor(s): Barry R. Bloom, PaulHenri Lambert, Academic Press, 2016, Pages xxi-xxiv.

REFERENCE BOOKS

1. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011
2. Burtis & Ashwood W.B. Tietz Textbook of Clinical chemistry. Saunders Company
3. Levine, M. M. (2004). New Generation Vaccines. New York: M. Dekker

VERTICAL 1: FINTECH AND BLOCK CHAIN

CMG331 FINANCIAL MANAGEMENT LT P C
3 0 0 3

LEARNING OBJECTIVES

1.To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy
5. To develop an understanding of tools on Working Capital Management.

UNIT I INTRODUCTION TO FINANCIAL MANGEMENT 9

Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.

UNIT II . SOURCES OF FINANCE 9

Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III INVESTMENT DECISIONS: 9

Investment Decisions: capital budgeting – Need and Importance – Techniques of Capital Budgeting -– Payback -ARR – NPV – IRR –Profitability Index.

Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV FINANCING AND DIVIDEND DECISION 9

Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinants of Capital structure- Designing an Optimum capital structure .

Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy

UNIT V WORKING CAPITAL DECISION 9

Working Capital Management: Working Capital Management - concepts - importance - Determinants of Working capital. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

TOTAL : 45 PERIODS

TEXT BOOKS

1. M.Y. Khan and P.K.Jain Financial management, Text, Tata McGraw Hill
2. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd

REFERENCES .

1. James C. Vanhorne –Fundamentals of Financial Management– PHI Learning,.
2. Prasanna Chandra, Financial Management,
3. Srivatsava, Mishra, Financial Management, Oxford University Press, 2011

CMG332 FUNDAMENTALS OF INVESTMENT LT P C
3 0 0 3

COURSE OBJECTIVES:

1. Describe the investment environment in which investment decisions are taken.
2. Explain how to Value bonds and equities
3. Explain the various approaches to value securities
4. Describe how to create efficient portfolios through diversification
5. Discuss the mechanism of investor protection in India.

UNIT1: THE INVESTMENT ENVIRONMENT 9

The investment decision process, Types of Investments – Commodities, Real Estate and FinancialAssets, the Indian securities market, the market participants and trading of securities, securitymarket indices, sources of financial information, Concept of return and risk, Impact of Taxes andInflationonreturn.

UNIT2: FIXED INCOME SECURITIES 9

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, defaultrisk andcreditrating.

UNIT3: APPROACHES TOEQUITYANALYSIS 9

Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT4: PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES 9

Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

UNIT5: INVESTOR PROTECTION 9

Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness andactivism

TOTAL : 45 PERIODS

REFERENCES

1. Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14TH Edition, 2019.
2. Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5th, Edition, 2017.
3. Rustagi, R. P. Investment Management Theory and Practice. Sultan Chand & Sons, 2021.
4. ZviBodie, Alex Kane, Alan J Marcus, PitabusMohanty, Investments, McGraw Hill Education (India), 11 Edition(SIE), 2019

CMG333 BANKING, FINANCIAL SERVICES AND INSURANCE LT P C
3 0 0 3

COURSE OBJECTIVES

- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India

- Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM **9**

Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS/ PRODUCTS **9**

Liquid Assets - Investment in securities - Advances - Loans.Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes.Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&A's of banks into securities market

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY **9**

Payment system in India – paper based – e payment –electronic banking –plastic money – e-money –forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.

UNIT IV FINANCIAL SERVICES **9**

Introduction – Need for Financial Services – Financial Services Market in India – NBFC –– Leasing and Hire Purchase –– mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking

UNIT V INSURANCE **9**

Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim

TOTAL : 45 PERIODS

REFERENCES :

1. Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2017.
2. Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi 2010
3. Peter S. Rose and Sylvia C. and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2017

CMG334 INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS **L T P C**
3 0 0 3

UNIT I INTRODUCTION TO BLOCKCHAIN **9**

Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

UNIT II INTRODUCTION TO CRYPTOCURRENCY **9**

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain

UNIT III Ethereum **9**

Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV WEB3 AND HYPERLEDGE ` **9**

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT V EMERGING TRENDS **9**

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

TOTAL : 45 PERIODS

REFERENCE

1. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018
3. ArshdeepBahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.

CMG335 FINTECH PERSONAL FINANCE AND PAYMENTS **L T P C**
3 0 0 3

UNIT I CURRENCY EXCHANGE AND PAYMENT **9**

Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets -Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI).Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations.Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues

UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE **9**

A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering

UNIT III INSURETECH **9**

InsurTech Introduction , Business model disruption AI/ML in InsurTech ● IoT and InsurTech ,Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV PEER TO PEER LENDING **9**

P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

UNIT V REGULATORY ISSUES **9**

FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech, RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: StartupsRegTech, Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection

TOTAL : 45 PERIODS

REFERENCE

1. Swanson Seth, Fintech for Beginners: Understanding and Utilizing the power of technology, Createspace Independent Publishing Platform,2016.
2. Models AuTanda, Fintech Bigtech And Banks Digitalization and Its Impact On Banking Business, Springer, 2019
3. Henning Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations, Wildfire Publishing, 2016
4. Jacob William, FinTech:TheBeginner's Guide to Financial Technology, Createspace Independent Publishing Platform, 2016
5. IIBF, Digital Banking, Taxmann Publication, 2016
6. Jacob William, Financial Technology, Create space Independent Pub, 2016
7. Luke Sutton, Financial Technology: Bitcoin & Blockchain, Createspace Independent Pub, 2016

CMG336 **INTRODUCTION TO FINTECH** **LT P C**
3 0 0 3

COURSE OBJECTIVES:

1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION **9**

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY **9**

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY **9**

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.

UNIT IV FINTECH AROUND THE GLOBE **9**

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

UNIT V FUTURE OF FINTECH **9**

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL : 45 PERIODS

REFERENCES

1. Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015
2. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016
3. Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
5. Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications, 2020
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

VERTICAL 2: ENTREPRENEURSHIP

CMG337 FOUNDATIONS OF ENTREPRENERUSHIP

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To develop and strengthen the entrepreneurial quality and motivation of learners.
- To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of entrepreneurship and management in Technology oriented businessess.
- To empower the learners to run a Technology driven business efficiently and effectively

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entreprenrship to Economic Development.

UNIT II BUSINESS OWNERSHIP & ENVRIONMENT 9

Types of Business Ownership – Buiness Envrionemental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Reosurces Mobilisation-Basics of Managing Finance- Esentials of Marketing Management - Production and Operations Planning – Systems Management and Administration

UNITIII FUNDAMENTALS OF TECHNOPRENEURSHIP 9

Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characterisitcis of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportuinites in Technopreneurship - Recent trends

UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP 9

Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship -– Success Stories of Technopreneurs - Case Studies

UNIT V EMERGING TRENDS IN ENTREPRENERUSHIP 9

Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneruship - NGO Entrepreneurship – Recent Entrperneruial Develoments - Local – National – Global perspectives.

TOTAL45 : PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to:

CO 1 Learn the basics of Entrepreneurship

CO 2 Understand the business ownership patterns and evnironment

CO 3 Understand the Job opportunites in Industries relating to Technopreneurship

CO 4 Learn about applications of tehnopreneurship and successful technopreneurs

CO 5 Acquaint with the recent and emerging trends in entreprenerushipp

TEXT BOOKS:

1) S.S.Khanka, “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi, 2021.
2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,

REFERENCES :

1) Daniel Mankani. 2003. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall
2) Edward Elgar. 2007. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Edi: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub.
3) Lang, J. 2002, The High Tech Entrepreneur's Handbook, Ft.com.

4) David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
5) HarperBusiness,https://fanny.staff.uns.ac.id/files/2013/12/Technopreneur-BASED-EDUCATION-REVOLUTION.pdf
6) JumpStart: A Technoprenuership Fable, Dennis Posadas, (Singapore: Pearson Prentice Hall, 2009
7) Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8) Journal articles pertaining to Entrepreneurship

CMG338 TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To develop and strengthen the Leadership qualities and motivation of learners.
- To impart the Leadership skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of Team Building in managing Technology oriented businessess.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively

UNIT I INTRODUCTION TO MANAGING TEAMS 9

Introduction to Team - Team Dynamics - Team Formation – Stages of Team Devlopment - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS 9

Team-based Organisations- Leadershp roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP 9

Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment .

UNIT IV LEADERSHIP IN ORGANISATIONS 9

Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.

UNIT V LEADERSHIP EFFECTIVENESS 9

Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

TOTAL 45 : PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to:

CO 1 Learn the basics of managing teams for business.

CO 2 Understand developing effective teams for business management.

CO 3 Understand the fundamentals of leadership for running a business.

CO 4 Learn about the importance of leadership for business development.

CO 5 Acquaint with emerging trends in leadership effectiveness for entreprenerus.''

REFERENCES :

1. Hughes, R.L., Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the lessons of experience ,9th Ed, McGraw Hill Education, Chennai, India. (2019).
2. Katzenback, J.R., Smith, D.K., The Wisdom of Teams: Creating the High Performance Organisations, Harvard Business Review Press, (2015).
3. Haldar, U.K., Leadership and Team Building, Oxford University Press, (2010).
4. Daft, R.L., The Leadership Experience, Cengage, (2015).
5. Daniel Levi, Group Dynamics for Teams ,4th Ed, (2014), Sage Publications.
6. Dyer, W. G., Dyer, W. G., Jr., & Dyer, J. H..Team building: Proven strategies for improving team performance, 5thed, Jossey-Bass, (2013).

CMG339 CREATIVITY & INNOVATION IN ENTREPRENEURSHIP L T P C

3 0 0 3

COURSE OBJECTIVES

- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To know the applications of innovation in entprerenship.
- To develeop innovative business models for business.

UNIT I CREATIVITY 9

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment-Creative Technology- - Creative Personality and Motivation.

UNIT II CREATIVE INTELLIGENCE 9

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training--Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION 9

Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation-Innovation as Collective Change-Innovation as a system

UNIT IV INNOVATION AND ENTREPRENEURSHIP 9

Innovation and Entrepreneurship: Entrepreneurial Mindset , Motivations and Behaviours- Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit

Unit V INNOVATIVE BUSINESS MODELS 9

Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.

TOTAL 45 : PERIODS

COURSE OUTCOMES

Upon completion of this course, the student should be able to:

CO 1 Learn the basics of creativity for developing Entrepreneurship

CO 2 Understand the importance of creative inteligence for business growth

CO 3 Understand the advances through Innovation in Industries

CO 4 Learn about applications of innovation in building successful ventures

CO 5 Acquaint with developing innovative business models to run the business effecientlty and effectively

Suggested Readings:

Creativity and Inovation in Entrepreneurship, Kankha, Sultan Chand

Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata Mc Graw Hill, 2004.

Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.

Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.

Innovation Management, C.S.G. Krishnamacharyulu, R. Lalitha, Himalaya Publishing House, 2010.

A. Dale Timpe, Creativity, Jaico Publishing House, 2003.

Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.

Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.

CMG340 PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT 9

Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing - Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.

UNIT II MARKETING ENVIRONMENT **9**

Introduction - Environmental Scanning - Analysing the Organisation's Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.

UNIT III PRODUCT AND PRICING MANAGEMENT **9**

Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

UNIT IV PROMOTION AND DISTRIBTUION MANAGEMENT **9**

Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)- Logistics Management- Introduction to Retailing and Wholesaling.

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT **9**

Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing - E-Marketing or Online Marketing.

TOTAL 45 : PERIODS

COURSE OUTCOMES:

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

CO1 Have the awareness of marketing management process

CO 2 Understand the marketing environment

CO 3 Acquaint about product and pricing strategies

CO 4 Knowledge of promotion and distribution in marketing management.

CO 5 Comprehend the contemporary marketing scenairos and offer solutions to marketing issues.

REFERENCES:

1. Marketing Management, Sherlekar S.A, Himalaya Publishing House, 2016.

2. Marketing Management , Philip Kortler and Kevin Lane Keller, PHI 15th Ed, 2015.

3 Marketing Management- An Indian perspective, Vijay Prakash Anand, Biztantra, Second edition, 2016.

4. Marketing Management Global Perspective, Indian Context, V.S.Ramaswamy & S.Namakumari, Macmillan Publishers India,5th edition, 2015.

5. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.

6. Marketing Management- text and Cases, Dr. C.B.Gupta & Dr. N.Rajan Nair, 17th edition, 2016.

CMG341 HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I INTRODUCTION TO HRM **9**

Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM.

UNIT II HUMAN RESOURCE PLANNING **9**

HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III RECRUITMENT AND SELECTION **9**

Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT **9**

Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices

UNIT V CONTROLLING HUMAN RESOURCES **9**

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends

TOTAL 45 : PERIODS

COURSE OUTCOMES

Upon completion of this course the learners will be able:

CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers

CO 2 To learn about the HR Planning Methods and practices.

CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.

CO 4 To known about the methods of Training and Employee Development.

CO 5 To comprehend the techniques of controlling human resources in organisations.

REFERENCES

1) Gary Dessler and Biju Varkkey, Human Resource Management, 14e , Pearson, 2015.
2) Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
3) David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014
4) R. Wayne Mondy, Human Resource Management, Pearson , 2015.

5) Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012
6) John M. Ivancevich, Human Resource Management,12e, McGraw Hill Irwin,2013.
7) K. Aswathappa, Sadhna Dash , Human Resource Management - Text and Cases , 9th Edition, McGraw Hill, 2021.
8) Uday Kumar Haldar, Juthika Sarkar. Human Resource management. Oxford. 2012

CMG342 FINANCING NEW BUSINESS VENTURES L T P C
3 0 0 3

COURSE OBJECTIVES

- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and quity financing.
- To empower the learners towards fund rasiing for new ventures effectively.

UNIT I ESSENTIALS OF NEW BUSINES VENTURE 9

Setting up new Business Ventures – Need - Scope - Franchising - Location Strategy, Registration Process - State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.

UNIT II INTRODUCTION TO VENTURE FINANCING 9

Venture Finance – Definition – Historic Background - Funding New Ventures- Need – Scope – Types - Cost of Project - Means of Financing - Estimation of Working Capital - Requirement of funds – Mix of Dent and Equity - Challenges and Opportunities.

UNIT III SOURCES OF DEBT FINANCING 9

Fund for Capital Assets - Term Loans - Leasing and Hire-Purchase - Money Market instruments – Bonds, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.

UNIT IV SOURCES OF EQUITY FINANCING 9

Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES 9

Investor Decision Process - Identifying the appropriate investors- Targeting investors- Developing Relationships with investors - Investor Selection Criteria- Company Creation- Raising Funds - Seed Funding- VC Selection Criteria – Process- Methods- Recent Trends

TOTAL 45 : PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students should be able to:

CO 1 Learn the basics of starting a new business venture.
CO 2 Understand the basics of venture financing.
CO 3 Understand the sources of debt financing.
CO 4 Understanf the sources of equity financing.
CO 5 Acquaint with the methods of fund raising for new business ventures.

REFERENCES :

1) Principles of Corporate Finance by Brealey and Myers et al.,12TH ed, McGraw Hill Education (India) Private Limited, 2018
2) Prasanna Chandra, Projects : Planning ,Analysis,Selection ,Financing,Implementation and Review, McGraw Hilld Education India Pvt Ltd ,New Delhi , 2019.
3) Introduction to Project Finance. Andrew Fight,Butterworth-Heinemann, 2006.
4) Metrick, Andrew; Yasuda, Ayako. Venture Capital And The Finance Of Innovation. Venture Capital And The Finance Of Innovation, 2nd Edition, Andrew Metrick And Ayako Yasuda, Eds., John Wiley And Sons, Inc, 2010.
5) Feld, Brad; Mendelson, Jason. Venture Deals. Wiley, 2011.
6) May, John; Simons, Cal. Every Business Needs An Angel: Getting The Money You Need To Make Your Business Grow. Crown Business, 2001.
7) Gompers, Paul Alan; Lerner, Joshua. The Money Of Invention: How Venture Capital Creates New Wealth. Harvard Business Press, 2001.
8) Camp, Justin J. Venture Capital Due Diligence: A Guide To Making Smart Investment Choices And Increasing Your Portfolio Returns. John Wiley & Sons, 2002.
9) Byers, Thomas. Technology Ventures: From Idea To Enterprise. Mcgraw-Hill Higher Education, 2014.
10) Lerner, Josh; Leamon, Ann; Hardymon, Felda. Venture Capital, Private Equity, And The Financing Of Entrepreneurship. 2012.

VERTICAL 3: PUBLIC ADMINISTRATION

CMG343 PRINCIPLES OF PUBLIC ADMINISTRATION **L T P C**
3 0 0 3

UNIT-I **(9)**

1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT-II **(9)**

1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT-III **(9)**

1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT-IV **(9)**

1. Bureaucratic Approach: Max Weber
2. Human Relations Approach : Elton Mayo

3. Ecological Approach : Riggs

UNIT-V **(9)**

1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers
3. Decision Making: Decision Making - Types, Techniques and Processes.

TOTAL: 45 PERIODS

REFERENCEs:

1. Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.
2. Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.
3. R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.
4. Rumki Basu: Public Administration:Concept and Theories, New Delhi:Sterling, 2013.
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

CMG344 **CONSTITUTION OF INDIA** **L T P C**
3 0 0 3

UNIT-I **(9)**

1. Constitutional Development Since 1909 to 1947
2. Making of the Constitution.
3. Constituent Assembly

UNIT-II **(9)**

1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT-III **(9)**

1. President
2. Parliament
3. Supreme Court

UNIT-IV **(9)**

1. Governor
2. State Legislature
3. High Court

UNIT-V **(9)**

1. Secularism
2. Social Justice
3. Minority Safeguards

TOTAL: 45 PERIODS

REFERENCES:

1. Basu. D.D.: Introduction to Indian Constitution ; Prentice Hall; New Delhi.
2. Kapur. A.C: Indian Government and Political System; S.Chand and Company Ltd., New Delhi.
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi

4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

CMG345 PUBLIC PERSONNEL ADMINISTRATION L T P C
3 0 0 3

UNIT-I (9)

1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II (9)

1. Generalist Vs Specialist
2. Civil Servants' Relationship with Political Executive
3. Integrity in Administration.

UNIT-III (9)

1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

UNIT-IV (9)

1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT-V (9)

1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

TOTAL: 45 PERIODS

REFERENCES:

1. Stahl Glean O: Public Personnel Administration
2. Parnandikar Pai V.A: Personnel System for Development Administration.
3. Bhambhiru . P: Bureaucracy and Policy in India.
4. Dwivedi O.P and Jain R.B: India's Administrative state.
5. Muttalis M.A: Union Public Service Commission.
6. Bhakara Rao .V: Employer Employee Relations in India.
7. Davar R.S. Personnel Management & Industrial Relations

CMG346 ADMINISTRATIVE THEORIES L T P C
3 0 0 3

UNIT I (9)

Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration

UNIT II **(9)**

Theories of Organization: Scientific Management Theory, Classical Model,
Human Relations Theory

UNIT III **(9)**

Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.

UNIT IV **(9)**

Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making

UNIT V **(9)**

Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker

TOTAL: 45 PERIODS

REFERENCES:

1. Crozior M : The Bureaucratic phenomenon (Chand)
2. Blau. P.M and Scott. W : Formal Organizations (RKP)
3. Presthus. R : The Organizational Society (MAC)
4. Alvi, Shum Sun Nisa : Eminent Administrative Thinkers.
5. Keith Davis : Organization Theory (MAC)

CMG347 INDIAN ADMINISTRATIVE SYSTEM L T P C
3 0 0 3

UNIT I **(9)**

Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

UNIT II **(9)**

Role & Functions of the District Collector, Relationship between the District
Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government

UNIT III **(9)**

Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT IV **(9)**

Coalition politics in India, Integrity and Vigilance in Indian Administration

UNIT V **(9)**

Corruption – Ombudsman, Lok Pal & Lok Ayuktha

TOTAL: 45 PERIODS

REFERENCES:

1. S.R. Maheswari : Indian Administration
2. Khera. S.S : Administration in India
3. Ramesh K. Arora : Indian Public Administration
4. T.N. Chaturvedi : State administration in India
5. Basu, D.D : Introduction to the Constitution of India

CMG348 PUBLIC POLICY ADMINISTRATION L T P C
3 0 0 3

UNIT-I (9)

Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration.

UNIT-II (9)

Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model

UNIT-III (9)

Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation.

UNIT-IV (9)

Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.

UNIT-V (9)

Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

TOTAL: 45 PERIODS

REFERENCES:

1. Rajesh Chakrabarti & Kaushik Sanyal : Public Policy in India, Oxford University Press, 2016.
2. Kuldeep Mathur : Public Policy and Politics in India, Oxford University Press, 2016.
3. Bidyutv Chakrabarty: Public Policy: Concept, Theory and Practice, 2015.
4. Pradeep Saxena : Public Policy Administration and Development
5. Sapru R.K. : Public Policy: Formulation, Implementation and Evaluation, Sterling Publishers, 2016.

VERTICAL 4: BUSINESS DATA ANALYTICS

CMG349 STATISTICS FOR MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVE:

- To learn the applications of statistics in business decision making.

UNIT I INTRODUCTION **9**

Basic definitions and rules for probability, Baye‘s theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION **9**

Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT III TESTING OF HYPOTHESIS - PARAMETIRC TESTS **9**

Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS **9**

Chi-square tests for independence of attributes and goodness of fit, Kolmogorov-Smirnov – test for goodness of fit, Mann – Whitney U test and Kruskal Wallis test.

UNIT V CORRELATION AND REGRESSION **9**

Correlation –Rank Correlation – Regression – Estimation of Regression line – Method of Least Squares – Standard Error of estimate.

TOTAL:45 PERIODS

COURSE OUTCOMES:

- To facilitate objective solutions in business decision making.
- To understand and solve business problems
- To apply statistical techniques to data sets, and correctly interpret the results.
- To develop skill-set that is in demand in both the research and business environments
- To enable the students to apply the statistical techniques in a work setting.

REFERENCES:

1. Richard I. Levin, David S. Rubin, Masood H.Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.
2. Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.
3. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.
4. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.
5. David R. Anderson, Dennis J. Sweeney, Thomas A.Williams, Jeffrey D.Camm, James J.Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016.
6. N. D. Vohra, Business Statistics, Tata McGraw Hill, 2017.

CMG350 DATAMINING FOR BUSINESS INTELLIGENCE **L T P C**
3 0 0 3

COURSE OBJECTIVES :

- To know how to derive meaning form huge volume of data and information.

- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION **9**

Data mining, Text mining, Web mining, Data ware house.

UNIT II DATA MINING PROCESS **9**

Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES **9**

Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES **9**

Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI **9**

Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Learn to apply various data mining techniques into various areas of different domains.
CO2: Be able to interact competently on the topic of data mining for business intelligence.
CO3: Apply various prediction techniques.
CO4: Learn about supervised and unsupervised learning technique.
CO5: Develop and implement machine learning algorithms

REFERENCES :

1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
3. W.H.Inmon, Building the Data Warehouse, fourth edition Wiley India pvt. Ltd. 2005.
4. Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd edition,2013.
5. Michel Berry and Gordon Linoff, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition, 2011
6. Michel Berry and Gordon Linoff, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 2011
7. G. K. Gupta, Ïntroduction to Data mining with Case Studies, Prentice hall of India, 2011
8. Giudici, Applied Data mining – Statistical Methods for Business and Industry, John Wiley. 2009
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011
10. Michalewicz Z., Schmidt M. Michalewicz M and Chiriac C, Adaptive Business Intelligence, Springer – Verlag, 2007
11. GalitShmueli, Nitin R. Patel and Peter C. Bruce, Data Mining for Business Intelligence – Concepts, Techniques and Applications Wiley, India, 2010.

CMG351 HUMAN RESOURCE ANALYTICS L T P C

3 0 0 3

COURSE OBJECTIVE:

- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

UNIT I - INTRODUCTION TO HR ANALYTICS 9

People Analytics - stages of maturity - Human Capital in the Value Chain : impact on business – HR metrics and KPIs.

UNIT II - HR ANLYTICS I: RECRUITMENT 9

Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire.

UNIT III - HR ANALYTICS - TRAINING AND DEVELOPMENT 9

Training & Development Metrics : Percentage of employees trained- Internally and externally trained -Training hours and cost per employee - ROI.

UNIT IV - HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION 9

Employee Engagement Metrics :Talent Retention index - Voluntary and involuntary turnover- grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT V - HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT 9

Workforce Diversity and Development Metrics : Employees per manager – Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity
index - Gender mix

TOTAL: 45 PERIODS

COURSE OUTCOME:

- The learners will be conversant about HR metrics and ready to apply at work settings.
- The learners will be able to resolve HR issues using people analytics.

REFERENCES:

1. JacFitzenz , The New HR Analytics, AMACOM , 2010.
2. Edwards M. R., & Edwards K, Predictive HR Analytics: Mastering the HR Metric.London: Kogan Page.2016.
3. Human Resources kit for Dummies – 3 rd edition – Max Messmer, 2003
4. Dipak Kumar Bhattacharyya, HR Analytics ,Understanding Theories and Applications, SAGE Publications India ,2017.
5. Sesil, J. C. , Applying advanced analytics to HR management decisions: Methods fo selection, developing incentives, and improving collaboration. Upper Saddle River,New Jersey: Pearson Education,2014.
6. Pease, G., & Beresford, B, Developing Human Capital: Using Analytics to Plan and Optimize Your Learning and Development Investments. Wiley ,2014.

7. Phillips, J., & Phillips, P.P, Making Human Capital Analytics Work: Measuring the ROI of Human Capital Processes and OUTCOME. McGraw-Hill,2014.
8. HR Scorecard and Metrices, HBR, 2001.

CMG352 MARKETING AND SOCIAL MEDIA WEB ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVE:

- To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I - MARKETING ANALYTICS 9

Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II - COMMUNITY BUILDING AND MANAGEMENT 9

History and Evolution of Social Media-Understanding Science of Social Media –Goals for using Social Media- Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages-Linking Social Media Accounts-The Viral Impact of Social Media.

UNIT III - SOCIAL MEDIA POLICIES AND MEASUREMENTS 9

Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV - WEB ANALYTICS 9

Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V - SEARCH ANALYTICS 9

Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:

1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
3. Bittu Kumar, Social Networking, V & S Publishers, 2013
4. Avinash Kaushik, Web Analytics - An Hour a Day, Wiley Publishing, 2007
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004
6. Takeshi Moriguchi, Web Analytics Consultant Official Textbook, 7th Edition, 2016

CMG353 OPERATION AND SUPPLY CHAIN ANALYTICS L T P C

3 0 0 3

COURSE OBJECTIVE:

- To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

UNIT I - INTRODUCTION **9**

Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT II - WAREHOUSING DECISIONS **9**

P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III - INVENTORY MANAGEMENT **9**

Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV - TRANSPORTATION NETWORK MODELS **9**

Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Transportation Problems, Set covering and Set Partitioning Problems, Travelling Salesman Problem, Scheduling Algorithms.

UNIT V - MCDM MODELS **9**

Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic an Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:

1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.
2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.
3. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
4. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management , I.K. International Publishing House Pvt. Ltd., 2016.
5. Gerhard J. Plenert, Supply Chain Optimization through Segmentation and Analytics, CRC Press, Taylor & Francis Group, 2014.

CMG354 **FINANCIAL ANALYTICS** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

- This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I - CORPORATE FINANCE ANALYSIS **9**

Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II - FINANCIAL MARKET ANALYSIS **9**

Estimation and prediction of risk and return (bond investment and stock investment) –Time series- examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III - PORTFOLIO ANALYSIS **9**

Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV - TECHNICAL ANALYSIS **9**

Prediction using charts and fundamentals – RSI, ROC, MACD, moving average and candle charts, simulating trading strategies. Prediction of share prices.

UNIT V - CREDIT RISK ANALYSIS **9**

Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

COURSE OUTCOME

- The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:

1. Financial analytics with R by Mark J. Bennett, Dirk L. Hugen, Cambridge university press.
2. Haskell Financial Data Modeling and Predictive Analytics Paperback – Import, 25 Oct 2013 by Pavel Ryzhov.
3. Quantitative Financial Analytics: The Path To Investment Profits Paperback – Import, 11 Sep 2017 by Edward E Williams (Author), John A Dobelman.
4. Python for Finance - Paperback – Import, 30 Jun 2017 by Yuxing Yan (Author).
5. Mastering Python for Finance Paperback – Import, 29 Apr 2015 by James Ma Weiming.

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

CES331 SUSTAINABLE INFRASTRUCTURE DEVELOPMENT **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.

UNIT I SUSTAINABLE DEVELOPMENT GOALS 9

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands – Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian – Infrastructure Project finance – Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

UNIT II SUSTAINABLE INFRASTRUCTURE PLANNING 9

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement &Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

UNIT III SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES 9

Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT IV SUSTAINABLE CONSTRUCTION MATERIALS 9

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility – Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies

UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS 9

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and

Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .

TOTAL: 45 PERIODS

COURSE OUTCOME:

On completion of the course, the student is expected to be able to

CO1 Understand the environment sustainability goals at global and Indian scenario.

CO2 Understand risks in development of projects and suggest mitigation measures.

CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.

CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.

CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:

1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.
5. New Building Materials and Construction World magazine
6. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher:Belhaven Press,ISBN:1852930039.
7. Munier N, "Introduction to Sustainability", Springer2005
8. Sharma, “Sustainable Smart Cities In India: Challenges And Future Perspectives”, SPRINGER, 2022.
9. Ralph Horne, Tim Grant, KarliVerghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing,2009
10. European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union;2010
11. Hudson, Haas, Uddin, Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation, McGraw Hill, (1997).
12. GregerLundesjö, Supply Chain Management and Logistics in Construction: Delivering Tomorrow's Built Environment, Kogan Page Publishers, 2015.

CO’s- PO’s & PSO’s MAPPING

CO’s	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2		1	1		2	3	1	1		2	1	1	2	1

2	3	1	3	2	1	2	2		1	1	1	2	2	2	2
3	2	2	3	1	1	1	1				1	1	1	3	1
4	3	1	3	2	2	1	3	1	1	1	1	2	2	2	2
5	3	1	2	2	2	2	3	1		1	1	2	2	3	2
Avg.	3	1	3	2	2	2	3	1	1	1	1	2	2	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

CES332 SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS 9

Ecosystem definition - Biotic *Vs*. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT 9

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT 9

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV ENERGY AND WASTE MANAGEMENT 9

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS 9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production **-** Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

COURSE OUTCOME

- On completion of the course, the student is expected to be able to

CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture

CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases

CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources

CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas

CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
2. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020
3. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016
4. Principles of Agronomy for Sustainable Agriculture, Villalobos, F.J. & Fereres, E., Springer, 2016
5. Sustainable Agriculture for Food Security: A Global Perspective, Balkrishna, A., CRC Press, 2021
6. Sustainable Energy Solutions in Agriculture, Bundschuh, J. & Chen, G., CRC Press, 2014

CO's-PO's & PSO's MAPPING- SUSTAINABLE AGRICULTURE PRACTICES

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1		2						2		2			2	2	
2		2		2	2	2							3	2	
3				2		2							3	2	3
4	3	2			2			2	2	2	2		3	2	3
5		2	3	2			1					1		2	
Avg.	3	2	3	2	2	2	1	2	2	2	2	1	3	2	3

1 – Low; 2 – Medium; 3 – High; '- "– No correlation

CES333 SUSTAINABLE BIOMATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES

- To Impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT-I INTRODUCTION TO BIOMATERIALS 9

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous

materials-Bonding types- crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials

UNIT-II BIO POLYMERS 9

Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT-III BIO CERAMICS AND BIOCOMPOSITES 9

General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon-Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Compsite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)–glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT-IV METALS AS BIOMATERIALS 9

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

UNIT-V NANOBIOMATERIALS 9

Meatllicnanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites -Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize-nanofibres-Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics-Nanomedicines- Biochips – Biomimetics-BioNEMs -Biosensor**-**Bioimaging/Molecular Imaging**-** challenges and future perspective.

TOTAL : 45 PERIODS

COURSE OUTCOMES

CO1: Students will gain familiarity with Biomaterials and they will understand their importance.
CO2: Students will get an overview of different biopolymers and their properties
CO3: Students gain knowledge on some of the important Bioceramics and Biocomposite materials
CO4: Students gain knowledge on metals as biomaterials
CO5: Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES

1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani “Introduction to Biomaterials Basic Theory with Engineering Applications” Cambridge University Press, 2014.
2. Donglu shi “Introduction to Biomaterials” Tsinghua University press, 2006.
3. Joon Park, R.S.Lakes “Biomaterials An Introduction” third edition, Springer 2007.
4. M.Jaffe,W.Hammond, P.Tolias and T.Arinzeh “Characterization of Biomaterials” Wood head publishing, 2013.
5. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science “An Introduction to Material in Medicine” Third Edition, 2013.
6. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

7. Leopoido Javier Rios Gonzalez. “Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process” Apple academic press, 2021.
8. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad “Functional Bionanomaterials” springer, 2020.
9. Sujata.V.Bhat Biomaterials; Narosa Publishing house, 2002.

CES334 MATERIALS FOR ENERGY SUSTAINABILITY L T P C
3 0 0 3

COURSE OBJECTIVES

- To familiarize the students about the challenges and demands of energy sustainability
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell
- To enable students to appreciate novel materials and their usage in photovoltaic application
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT-I SUSTAINABLE ENERGY SOURCES 9

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT-II ELECTROCHEMICAL DEVICES 9

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O_2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, $LiCoO_2$, $LiFePO_4$, $LiMn_2O_4$) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT-III FUEL CELLS 9

Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

UNIT-IV PHOTOVOLTAICS 9

Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – $Cu(InGa)Se_2$ solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-

dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzine – fullerenes - boron subphthalocyanine-tin (II) phthalocyanine)

UNIT-V SUPERCAPACITORS **9**

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

COURSE OUTCOMES

CO1: Students will acquire knowledge about energy sustainability.
CO2: Students understand the principles of different electrochemical devices.
CO3: Students learn about the working of fuel cells and their application.
CO4: Students will learn about various Photovoltaic applications and the materials used.
CO5: The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES

1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.
2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.
3. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer Academic / Plenum publishers, New York, 1999.
4. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002.
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh
6. Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.
7. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and VenkataramanThangadurai, J. Mater. Chem. A, 2022.
8. Review of next generation photovoltaic solar cell technology and comparative materialistic development Neeraj Kant, Pushpendra Singh, Materials Today: Proceedings, 2022.

CES335 **GREEN TECHNOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To provide green engineering solutions to energy demand, reduced energy footprint.

UNIT I PRINCIPLES OF GREEN CHEMISTRY 9

Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

UNIT II POLLUTION TYPES 9

Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT III GREEN REAGENTS AND GREEN SYNTHESIS 9

Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT IV DESIGNING GREEN PROCESSES 9

Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT V GREEN NANOTECHNOLOGY 9

Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: To understand the principles of green engineering and technology
CO2: To learn about pollution using hazardous chemicals and solvents
CO3: To modify processes and products to make them green and safe.
CO4: To design processes and products using green technology
CO5 – To understand advanced technology in green synthesis

TEXT BOOKS

1. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997
2. Green Chemistry – An introductory text - M. Lancaster, RSC,2016.
3. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) , Wiley publications,2008

REFERENCE BOOKS

1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336 ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS L T P C
3 0 0 3

COURSE OBJECTIVES:

- to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I: ENVIRONMENTAL MONITORING AND STANDARDS 9

Introduction- Environmental Standards- Classification of Environmental Standards- Global Environmental Standards- Environmental Standards in India- Ambient air quality standards- water quality standard- Environmental Monitoring-Need for environmental monitoring- Concepts of environmental monitoring- Techniques of Environmental Monitoring.

UNIT II: MONITORING OF ENVIRONMENTAL PARAMETERS 9

Current Environmental Issues- Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.

UNIT III: ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV : ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT 9

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment- hazard identification- exposure assessment- dose-response assessment; risk characterization.

UNIT V: AUTOMATED DATA ACQUISITION AND PROCESSING 9

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students will know

CO1	Basic concepts of environmental standards and monitoring.
CO2	the ambient air quality and water quality standards;
CO3	the various instrumental methods and their principles for environmental monitoring
CO4	The significance of environmental standards in monitoring quality and sustainability of the environment.
CO5	the various ways of raising environmental awareness among the people.
CO6	Know the standard research methods that are used worldwide for monitoring

	the environment.

TEXTBOOKS

1. Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soild wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES

1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
2. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
3. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.

CO's-PO's & PSO's MAPPING

Course Outcomes	Program Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	-	-	-	-	-	-	-	3	-	-
CO2	1	1	1	1	1	-	-	-	1	-	2	2	2	1	1
CO3	1	1	2	1	1	-	-	-	2	-	1	1	1	-	-
CO4	1	2	3	3	1	-	-	-	2	-	3	3	1	-	-
CO5	1	1	3	2	1	-	-	-	3	-	3	1	2	-	-
CO6	3	2	3	3	2	-	-	-	3	-	3	3	3	1	1
Over all	3	2	3	3	2	-	-	-	3	-	3	3	3	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

CES337 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development

UNIT I ENERGY SCENARIO 9

Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

UNIT II ENERGY AND ENVIRONMENT 9

Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution –

Environmental standards - measurement and controls

UNIT III SUSTAINABLE DEVELOPMENT 9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) - Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization and Economic growth - Economic development: Economic inequalities, Income and growth.

UNIT IV RENEWABLE ENERGY TECHNOLOGY 9

Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans – Principle of operation, relative merits and demerits

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT 9

National & State Energy Policy - National solar mission - Framework of Central Electricity Authority - National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Road map for ethanol blending, Energy Efficiency and Energy Mix

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Understand the world and Indian energy scenario

CO2: Analyse energy projects, its impact on environment and suggest control strategies

CO3: Recognise the need of Sustainable development and its impact on human resource development

CO4: Apply renewable energy technologies for sustainable development

CO5: Fathom Energy policies and planning for sustainable development.

REFERENCES:

1. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
2. Robert Ristirer and Jack P. Kraushaar, “Energy and the environment”, Willey, 2005.
3. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012
4. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.
5. Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press, 2006.
6. M.H. Fulekar,Bhawana Pathak, R K Kale,“Environment and Sustainable Development” Springer,2016
7. https://www.niti.gov.in/verticals/energy

CES338 ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT L T P C

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COURSE OBJECTIVES:

1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT 9

Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING 9

Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES 9

Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT IV ENERGY CONSERVTION IN ELECTRICAL UTILITIES 9

Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V SUSTAINABLE DEVELOPMENT 9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG). Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty,

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Understand the prevailing energy scenario
CO2: Familiarise on energy audits and its relevance
CO3: Apply the concept of energy audit on thermal utilities
CO4: Employ relevant techniques for energy improvement in electrical utilities
CO5: Understand Sustainable development and its impact on human resource development

REFERENCES:

1. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
2. Eastop.T.D& Croft D.R, “Energy Efficiency for Engineers and Technologists”, Logman Scientific & Technical, ISBN-0-582-03184, 1990
3. W.R. Murphy and G. McKay “Energy Management” Butterworths, London 1987
4. Pratap Bhattacharyya, “Climate Change and Greenhouse Gas Emission”, New India Publishing Agency- Nipa,2020

5. Matthew John Franchetti , Defne Apul “Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies” CRC Press,2012
6. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, “Energy and the Environment”, 4th Edition,Wiley,2022
7. M.H. Fulekar,Bhawana Pathak, R K Kale,“Environment and Sustainable Development” Springer,2016
8. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.