RAJALAKSHIMI ENGINEERING COLLEGE
An Autonomous Institution
Affiliated to Anna University Chennai

LIST OF OPEN ELECTIVES
REGULATIONS 2017

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OAE1701	Introduction to Aeronautical Engineering	OE	3	3	0	0	3
2.	OAE1702	Fundamentals of Jet Propulsion	OE	3	3	0	0	3
3.	OAE1703	Introduction to space flight	OE	3	3	0	0	3
4.	OAE1704	Industrial Aerodynamics	OE	3	3	0	0	3
5.	OAT1701	Automotive Systems	OE	3	3	0	0	3
6.	OAT1702	Automotive Sensors and Actuators	OE	3	3	0	0	3
7.	OAT1703	Elements of Electric and Hybrid vehicles	OE	3	3	0	0	3
8.	OAT1704	Fundamentals of Automotive Electronics	OE	3	3	0	0	3
9.	OBM1701	Anatomy and Physiology for Engineers	OE	3	3	0	0	3
10.	OBM1702	Biomaterials and Artificial Organs	OE	3	3	0	0	3
11.	OBM1703	Fundamentals of Medical Instrumentation	OE	3	3	0	0	3
12.	OBM1704	Engineering Mechanics for Medical Applications	OE	3	3	0	0	3
13.	OBM1705	Basics of Biosensors and Biophotonics	OE	3	3	0	0	3
14.	OBT1701	Basic Bioinformatics	OE	3	3	0	0	3
15.	OBT1702	Biotechnology in Product Development	OE	3	3	0	0	3
16.	OBT1703	Food and Nutrition	OE	3	3	0	0	3
17.	OBT1704	Medical Sciences for Engineers	OE	3	3	0	0	3

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
18.	OBT1705	Application of Biotechnology for Environmental protection	OE	3	3	0	0	3
19.	OBT1706	Fermentation Technology	OE	3	3	0	0	3
20.	OCH1701	Introduction to Fertilizer Technology	OE	3	3	0	0	3
21.	OCH1702	Introduction to Petroleum Technology	OE	3	3	0	0	3
22.	OCH1703	Unit operations in Environmental Engineering	OE	3	3	0	0	3
23.	OCH1704	Process Technology	OE	3	3	0	0	3
24.	OCH1705	Petrochemical Processing	OE	3	3	0	0	3
25.	OCH1706	Recent trends in water treatment	OE	3	3	0	0	3
26.	OCE1701	Disaster Management	OE	3	3	0	0	3
27.	OCE1702	Coastal Zone Management	OE	3	3	0	0	3
28.	OCE1703	Smart Structures and Smart Materials	OE	3	3	0	0	3
29.	OCE1704	Non Destructive Testing of Materials	OE	3	3	0	0	3
30.	OCE1705	Basics of Architecture	OE	3	3	0	0	3
31.	OCE1706	Global Warming and Climate Change	OE	3	3	0	0	3
32.	OCS1701	Web Design and Management	OE	3	3	0	0	3
33.	OCS1702	Mobile Application Development	OE	3	3	0	0	3
34.	OCS1703	Fundamentals of Database	OE	3	3	0	0	3
35.	OCS1704	Web Programming with XML	OE	3	3	0	0	3
36.	OCS1705	IoT and its Applications	OE	3	3	0	0	3
37.	OCS1706	Programming in C	OE	4	2	0	2	3
38.	OCS1707	Programming in C++	OE	4	2	0	2	3
39.	OCS1708	Java Programming	OE	4	2	0	2	3

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
40.	OCS1709	Computer Programming	OE	4	2	0	2	3
41.	OEE 1701	Renewable Power Generation Systems	OE	3	3	0	0	3
42.	OEE1702	Electrical Safety and Quality Assurance	OE	3	3	0	0	3
43.	OEE1703	Sensors and Transducers	OE	3	3	0	0	3
44.	OEE1704	Electric Power Utilization	OE	3	3	0	0	3
45.	OEE1705	Electrical Machines	OE	3	3	0	0	3
46.	OEC1701	MEMS and its Applications	OE	3	3	0	0	3
47.	OEC1702	Consumer Electronics	OE	3	3	0	0	3
48.	OEC1703	Digital Image Processing and its applications	OE	3	3	0	0	3
49.	OEC1704	Pattern Recognition and Artificial Intelligence	OE	3	3	0	0	3
50.	OEC1705	Electronics Engineering	OE	3	3	0	0	3
51.	OIT1701	Data Science	OE	3	3	0	0	3
52.	OIT1702	Advanced Python Programming	OE	3	3	0	0	3
53.	OIT1703	Business Intelligence	OE	3	3	0	0	3
54.	OIT1704	Computer Vision	OE	3	3	0	0	3
55.	OIT1705	Cyber Security	OE	3	3	0	0	3
56.	OIT1706	Machine Learning and R Programming	OE	3	3	0	0	3
57.	OMT1701	Industrial Robotics	OE	3	3	0	0	3
58.	OMT1702	Elements of Automation	OE	3	3	0	0	3
59.	OMT1703	Bio-mechatronics	OE	3	3	0	0	3
60.	OMT1704	CNC Systems- Design And Applications	OE	3	3	0	0	3
61.	OMT1705	Mobile Robotics	OE	3	3	0	0	3

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
62.	OME1701	Design of Experiments	OE	3	3	0	0	3
63.	OME1702	Industrial Safety	OE	3	3	0	0	3
64.	OME1703	Quality Concept	OE	3	3	0	0	3
65.	OME1704	Fundamentals of Production Engineering	OE	3	3	0	0	3
66.	OME1705	Supply chain and Logistics Management	OE	3	3	0	0	3
67.	OME1706	Fundamentals of Mechanical Engineering	OE	3	3	0	0	3
68.	OMA1701	Computer based Numerical methods	OE	4	2	0	2	3
69.	OMA1702	Number theory and applications	OE	3	3	0	0	3
70.	OPH1701	Materials Synthesis and Characterization Techniques	OE	3	3	0	0	3
71.	OPH1702	Nanophysics	OE	3	3	0	0	3
72.	OCY1701	Green Chemistry in Energy and Environment	OE	3	3	0	0	3
73.	OCY1702	Interface Chemistry and Engineering	OE	3	3	0	0	3
74.	OGE1701	Human Rights	OE	3	3	0	0	3
75.	OGE1702	Foreign Language-Japanese	OE	3	3	0	0	3
76.	OGE1703	Foreign Language-German	OE	3	3	0	0	3
77.	OGE1704	Foreign Language-French	OE	3	3	0	0	3
78.	OGE1705	Programming Logic	OE	3	2	0	2	3
79.	OGE1706	Advanced Programming Logic	OE	3	2	0	2	3

OPEN ELECTIVES OFFERED BY DEPT OF AERONATICAL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OAE1701	Introduction to Aeronautical Engineering	OE	3	3	0	0	3
2	OAE1702	Fundamentals of Jet Propulsion	OE	3	3	0	0	3
3	OAE1703	Introduction to space flight	OE	3	3	0	0	3
4	OAE1704	Industrial Aerodynamics	OE	3	3	0	0	3

OAE1701 INTRODUCTION TO AERONAUTICAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce history and classification of aircraft
- To understand properties of atmosphere
- To study basic aerodynamics
- To introduce basic concepts of aircraft structure
- To introduce piston and jet engines
-

UNIT I AIRCRAFT CONFIGURATIONS 8

History of Flight-Wright brothers-Different types of flight vehicles, classification, components and functions of typical transport aircraft, Helicopter and UAV parts and functions.

UNIT II PROPERTIES OF ATMOSHPHERE 7

Physical properties and structure of the atmosphere, ISA, lapse rate –different layer of atmosphere-different types of altitudes-temperature, pressure and altitude relationships-calculations.

UNIT III BASICS OF AERODYNAMICS 12

Newton's law of motions applied to aeronautics - aerofoil and wing geometry, NACA series airfoils, generation of lift, Mach number and ranges, aerodynamic center, pressure coefs, aspect ratio, types of drag, induced drag, lift and drag curves, sweepback on wing, shock waves in supersonic flight-basics of Pitot tube.

UNIT IV AIRPLANE STRUCTURES AND MATERIALS 9

General types of construction, monocoque and semi-monocoque, typical wing and fuselage structure, metallic and non-metallic materials, use of aluminium alloy, titanium, stainless steel , plastics, composite materials and applications.

UNIT V POWER PLANTS 9

Basics about piston, turbojet, turboprop and turbofan - concept of propeller and jets for thrust production , principles of operation of rocket, types of rockets and typical applications, exploration into space- India

TOTAL: 45 PERIODS

OUTCOMES

- Identify the types and component of aircraft
- Understand properties of atmosphere

- Performs basic calculation on lift, drag and moment.
- Identifies suitable materials for aircraft structure
- Identifies types of jet and rocket engines

TEXT BOOKS

1. Anderson, J.D., "Introduction to Flight", Tata McGraw-Hill, 2010.

REFERENCES

1. Kermode, A.C., "Mechanics of Flight", Pearson Education; 11th edition.
2. Kermode, A.C., "Flight without Formula", Pearson Education; 5th edition .

OAE1702 FUNDAMENTALS OF JET PROPULSION

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the principles of operation of jet and rocket propulsion.
- Also to understand about the types, operation and performance of various parts of the gas turbine engines.

UNIT I FUNDAMENTALS OF GAS TURBINE ENGINES 8

Illustration of working of gas turbine engine – The thrust equation – Factors affecting thrust – Effect of pressure, velocity and temperature changes of air entering compressor – Methods of thrust augmentation – Characteristics of turboprop, turbofan and turbojet – Performance characteristics.

UNIT II BASICS OF GAS TURBINE ENGINE COMPONENTS 9

Subsonic and supersonic inlets for gas turbine engines – inlet performance – axial flow and centrifugal flow compressors and their efficiencies & principle of operation – gas turbine combustion chambers & types – axial flow turbines and their performance – jet engine nozzles and their efficiency

UNIT III RAMJET PROPULSION 8

Operating principle of ramjet engine – various components of ramjet engines and their efficiencies – Combustion in ramjet engine – critical, subcritical and supercritical modes of operation -ramjet engine and its performance characteristics – sample ramjet design calculations – flame stability problems in ramjet combustors –integral ram rockets.

UNIT IV HYPERSONIC AIRBREATHING PROPULSION 9

Introduction to hypersonic air breathing propulsion, hypersonic vehicles and supersonic combustion-need for supersonic combustion for hypersonic propulsion – salient features of scramjet engine and its applications for hypersonic vehicles – problems associated with supersonic combustion – engine/airframe integration aspects of hypersonic vehicles

UNIT V ROCKET PROPULSION **10**

Operating principle – specific impulse of a rocket – internal ballistics –solid propellant rockets – selection criteria of solid propellants –liquid propellant rockets – selection of liquid propellants – various feed systems for liquid rockets -thrust control in liquid rockets – cooling in liquid rockets and the associated heat transfer problems – advantages of liquid rockets over solid rockets - introduction to hybrid propulsion – advantages and limitations of hybrid propulsion -.Electrical propulsion – Arcjet, resistojet – MPD thrusters, nuclear propulsion.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Pearson education (2009).

REFERENCES

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Pearson Education Canada; 6th edition, 2008.
2. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
3. "Rolls Royce Jet Engine", Rolls Royce; 4th revised edition, 986.
4. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition,2014.

OAE1703 INTRODUCTION TO SPACE FLIGHT	L	T	P	C
	3	0	0	3

UNIT I HISTORY OF INTERNATIONAL SPACE FLIGHT **8**

Manned space flight – Mercury, Gemini, Apollo, Skylab, Apollo-Soyuz, Space shuttle, Soviet manned spaceflights and International manned space flight. Unmanned space flight – Earth observation, space environment, planetary exploration, space exploration, commercial satellites, military satellites.

UNIT II INDIAN SPACE PROGRAMME **8**

ISRO - Organisation structure, Test facilities, Launch facilities, tracking and control facilities, Launch vehicles – SLV, ASLV, PSLV, GSLV, GSLV III and future launch vehicles. Satellite programmes, human space flight programme. Chandrayaan, Mangalyaan.

UNIT III SKY COORDINATES AND MOTIONS **8**

Sky coordinates and motions - Earth Rotation - Sky coordinates - seasons - phases of the Moon - the Moon's orbit and eclipses - timekeeping (side real vs synodic period)

UNIT IV ORBITAL PRINCIPLES **12**

Kepler's laws, Newton's laws - angular momentum, total energy, orbital velocities, orbital properties – field of view, ground track, maximum time in view, number of revolutions per day, and revisit time. Useful orbits – low earth orbits, polar orbits, geostationary orbits, sun-synchronous orbit. Orbit establishment, orbital maneuvers – simple impulse maneuver, Hoffmann transfer, simple plane changes.

UNIT V SATELLITE DESIGN **9**

Mission, payload, launch vehicle and site selection, subsystems for attitude reference & control, power, thermal, orbital maintenance, data handling, TT&C, onboard computer, structure. Ground support systems. **TOTAL: 45 PERIODS**

TEXT BOOKS

1. Bruce A. Campbell and Samuel Walter McCandless, Jr., Introduction to Space Sciences and Spacecraft Applications, Gulf Professional Publishing (1996)

REFERENCES

1. 2. Brown, C. D., Spacecraft Mission Design, 2nd ed., AIAA Edu. Series (1998).
2. Escobal, P. R., Methods of Orbit Determination, 2nd ed., Krieger Pub. Co. (1976).
3. Web link: https://www.isro.gov.in/

OAE1704 INDUSTRIAL AERODYNAMICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To familiarize the learner with non-aeronautical uses of aerodynamics such as road vehicle, building aerodynamics and problems of flow induced vibrations.

UNIT I ATMOSPHERE 9

Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows

UNIT II WIND ENERGY COLLECTORS 9

Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory

UNIT III VEHICLE AERODYNAMICS 9

Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of racing car, trains and Hovercraft

UNIT IV BUILDING AERODYNAMICS 9

Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation and architectural aerodynamics

UNIT V FLOW INDUCED VIBRATIONS 9

Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.

TOTAL: 45 PERIODS

OUTCOMES

- Use of aerodynamics for non- aerodynamics such as vehicle, building.
- Solve the problems and able to analyse vibrations during flow

TEXT BOOKS

1. M. Sovran (Ed), "Aerodynamics and drag mechanisms of bluff bodies and Road vehicles", Plenum press, New York, 1978.
2. Sachs. P., "Winds forces in Engineering", Pergamum Press, 1978.

REFERENCES

1. Blevins. R.D., "Flow Induced Vibrations", Van Nostrand, 1990.
2. Calvent. N.G., "Wind Power Principles", Charles Griffin & Co., London, 1979.

OPEN ELECTIVE OFFERED BY DEPT OF AUTOMOBILE ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OAT1701	Automotive Systems	OE	3	3	0	0	3
2	OAT1702	Automotive Sensors and Actuators	OE	3	3	0	0	3
3	OAT1703	Elements of Electric and Hybrid vehicles	OE	3	3	0	0	3
4	OAT1704	Fundamentals of Automotive Electronics	OE	3	3	0	0	3

OAT1701 **AUTOMOTIVE SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

1. To understand the layout of an automobile and various parts of an engines.
2. To understand the working and types of engine auxiliary systems.
3. To provide knowledge about the working and types of transmission systems.
4. To understand the construction and working principle of steering, brakes and suspension systems.
5. To have the knowledge about alternative sources of energy.

UNIT I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components function and materials.

UNIT II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system, Turbo chargers (WGT, VGT), Engine emission control by three-way catalytic converter system, Emission norms (Euro and BS).

UNIT III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required - Electric and Hybrid Vehicles, Fuel Cell.

TOTAL 45 PERIODS

COURSE OUTCOMES:

1. Students will demonstrate the different layouts used in automobiles and function of all the engine parts.
2. Students can understand the various fuel supply systems, ignition and emission norms used in automotive engines.
3. Students will demonstrate the knowledge of various parts of transmission systems and its mechanism.
4. Students can able to understand the working of steering, brake and suspension systems.
5. Students will demonstrate an understanding of technological, environmental, and social impacts of alternative energy sources.

TEXT BOOKS:

1. Newton Steeds and Garret, "Motor Vehicles", 13th Edition, Butterworth, London, 2005
2. Heinz Hazler, "Modern Vehicle Technology", Butterworth, London, 2005

REFERENCE BOOKS:

1. Heldt P.M., "Automotive Chassis", Chilton Co., New York, 1990
2. Giri. N.K., "Automotive Mechanics", Khanna Publishers, New Delhi, 2005
3. Milliken & Milliken, "Race Car Vehicle Dynamics", SAE, 1995

OAT1702	**AUTOMOTIVE SENSORS AND ACTUATORS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. To make the students to understand the various types of sensors and its characteristics used in automobiles.
2. To make the students to understand the various types of sensors used for position and speed and their applications in automobiles.
3. To make the students to understand the various types of sensors used for acceleration, pressure, force and torque and their applications in automobiles.
4. To make the students to understand the various types of sensors used for temperature, flow and climate control and their applications in automobiles.
5. To make the students to understand the various types of optoelectronic sensors and Actuators used in automobiles

UNIT I INTRODUCTION 9

Automotive sensors, Terms, definitions, Automotive applications, Features of vehicle sensors, sensor classification: assignment and application, Characteristic curve types, Types of output signal, Error types and tolerance requirements, Reliability, Main requirements and trends, Over view of the physical effects for sensors, Overview and selection of sensor technologies.

UNIT II POSITION, SPEED AND RPM SENSORS 9

Position sensors: Characteristics, measured variables, Potentiometer sensors, Magnetically inductive type sensors, Wave-propagation sensors, GPS position and distance traveled measurement. **Speed and rpm sensors:** measured variables, measuring principles, relative rpm and speed measurement, Absolute rotating speed measurement.

Applications : Accelerator-pedal sensors: potentiometric accelerator pedal sensor, hall angular position sensors. **Engine speed sensors:** Application, Inductive speed sensors, Active speed sensors, Hall phase sensors, Speed sensors for transmission control, Wheel speed sensors, Micromechanical

yaw rate sensors, Piezoelectric "Tuning fork" yaw rate sensor. **Position sensors for transmission control**: application, requirements, Linear position determination on the basis of Hall switches, Rotational position determination on the basis of eddy currents. **Steering angle sensors:** Application and operating principle of steering angle sensor with AMR element and GMR element. **Axle sensors:** Application and operating principle

UNIT III ACCELERATION, PRESSURE, FORCE AND TORQUE SENSORS 9

Acceleration sensors: measured variables, Measuring principles: displacement or travel measuring system, systems for measuring mechanical stress, Thermal acceleration sensors, packaging. **Pressure sensors:** measured variables, Measuring principles: Direct pressure measurement, Diaphragm type sensors, Transfer to a force sensor. **Force and torque sensors:** measured variables, Measuring principles: Strain measuring force sensors, Travel measuring force sensors. **Torque sensor:** strain measuring sensor, angle measuring sensors, eddy current sensors.

Applications: Acceleration sensors: Surface micromechanical (SMM) acceleration sensors, Micromechanical bulk silicon acceleration sensors, piezoelectric acceleration sensors. **Micro mechanical pressure sensors**: application, Version with the reference vacuum on the component side, version with reference vacuum in a special chamber, High pressure sensors. **Force sensor, Torque sensor, Piezoelectric knock sensors:** application and operating principle, mounting.

UNIT IV TEMPERATURE , FLOW AND CLIMATE CONTROL SENSORS 9

Temperature sensors: Measured variables, Measuring principles for direct contact sensors: Resistive sensors, sintered ceramic NTC resistors, PTC thin-film / thick-film metallic resistors, thick film resistors (PTC/NTC), mono crystalline silicon semiconductor resistors (PTC), Thermocouples, semiconductor depletion layers. Measuring principles for non contacting temperature measurement: bolometer, thermopile sensor, single point sensors, imaging sensors. **Flow meters:** measured variables, Measuring principles. **Gas sensors and concentration sensors:** measured variables, Measuring principles

Applications: Temperature sensors: Application: engine temperature sensor, air temperature sensor, engine oil temperature sensor, fuel temperature sensor, exhaust gas temperature sensor, operating principles. **Hot film air mass meters:** application, HFM5 type, HFM6 type. **Climate control sensor.**

UNIT V OTHER SENSORS AND ACTUATORS 9

Optoelectronic sensors: Internal photoelectric effect, Light sensitive sensor elements: photo resistors, semiconductor PN junctions, Imaging sensors: intergrading photodiodes, CCD imaging sensors, CMOS imaging sensors. Applications of optoelectronics sensors.

Other Sensors: Working principle of Ultrasonic sensor, Rain/light sensor, Dirt sensor, Two sep lambda oxygen sensors, Planar wide band lambda oxygen sensors, crash sensor.

Actuators: Working of Solenoids, Relays and Electric motors: stepper motors, permanent Magnet field motors.

TOTAL 45 PERIODS

COURSE OUTCOMES:

1. The students will be able to explain the working of various sensors and its characteristics used in automobiles.
2. The students will be able to explain the working and selection of various sensors used to determine position and speed in automobiles.
3. The students will be able to explain the working and selection of various sensors used to determine acceleration, pressure, force and torque in automobiles.
4. The students will be able to explain the working and selection of various sensors used to determine temperature, flow and climate control in automobiles.

5. The students will be able to explain the working and selection of optoelectronic sensors and actuators used in automobiles.

TEXT BOOKS :

1 "Automotive Sensors" by Robert Bosch GmbH, 2007.
2 Joseph Bell "Diesel Engineering – Electricity and Electronics" Cengage learning, Indian Edition, 2007.

REFERENCE BOOKS:

1 Steve V. Hatch "Electronic Engine controls" Cengage learning, Indian Edition, 2009.
2 Sean Bennett "Diesel Engineering – Electronic diesel engine diagnosis" Cengage learning, Indian Edition, 2007.
3 Ian Sinclair, "Sensors and Transducers", Newnes, Elsevier, Indian Edition, 2011

OAT1703	ELEMENTS OF ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the methods of representation of system and their transfer function models
2. To provide adequate knowledge in the time response of systems and steady state error analysis
3. To give basic knowledge in obtaining the open loop and closed loop frequency responses of system
4. To understand the concept of stability of control system and methods of stability analysis
5. To study the three way of designing compensators for a control system

UNIT I NEED FOR ALTERNATIVE SYSTEM 9

Need of electric vehicles hybrid vehicles – comparative study of diesel, petrol, pure electric and hybrid vehicles. Limitations of electric vehicles. Specification of some electric and hybrid vehicles

UNIT II ENERGY SOURCES : BATTERIES AND FUEL CELLS 9

Battery Parameters-Power requirement of electric vehicles- Different types of batteries - Lead acid-Nickel based-Sodium based-Lithium based- Metal Air based. Battery charging- Charger design-Quick charging devices- Battery Modeling. Different type of energy storage – Solar, wind, compressed fluid. Fuel Cell- Fuel cell characteristics- Fuel cell types-Hydrogen fuel cell-Connecting cell in series- water management in the PEM fuel cell- Thermal Management of the PEM fuel cell

UNIT III PROPULSION MOTORS AND CONTROLLERS 12

Characteristic of permanent magnet and separately exited DC motors. AC single phase and 3-phase motor – inverters – DC and AC motor speed controllers.

UNIT IV VEHICLE DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 6

Aerodynamic-Rolling resistance- Transmission efficiency- Vehicle mass- Electric vehicle chassis and Body design considerations- Heating and cooling systems- Controllers- Power steering- Tyre choice- Wing Mirror, Aerials and Luggage racks

UNIT V HYBRID VEHICLES 9

Types of Hybrid- Series, parallel, split – parallel, series - parallel - Advantages and Disadvantages. Power split device – Energy Management System - Design consideration - Economy of hybrid vehicles

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. The student can understand the methods of representation of system and their transfer function models
2. The student possess adequate knowledge in the time response of systems and steady state error analysis
3. The student can have basic knowledge in obtaining the open loop and closed loop frequency responses of system
4. The student can understand the concept of stability of control system and methods of stability analysis
5. The student can know about three way of designing compensators for a control system

TEXT BOOKS:

1 James Larminie and John Lowry, "Electric Vehicle Technology Explained " John Wiley & Sons,2003
2 Iqbal Husain, " Electric and Hybrid Vehicles-Design Fundamentals", CRC Press,2003
3 Mehrdad Ehsani, " Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press,2005

REFERENCE BOOKS:

1 Ron HodKinson, " light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication,2005
2 Lino Guzzella, " Vehicle Propulsion System" Springer Publications,2005

OAT1704 FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS L T P C
3 0 0 3

OBJECTIVES:

1. To learn about the fundamental principles of automotive electronics
2. To know about the various sensors used in automobiles
3. To know about the electronic engine management systems for Petrol engines
4. To know about the electronic engine management systems for diesel engines
5. To understand the chassis management systems used in modern vehicles

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9

Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines and in the other parts of the automobile.

UNIT II SENSORS 9

Inductive, Hall effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, air mass flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen

level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors.

UNIT III SI ENGINE MANAGEMENT 9

Three way catalytic converter, conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Working of the fuel system components. Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop control of fuel injection and closed loop lambda control. Electronic ignition systems and spark timing control. Closed loop control of knock.

UNIT IV CI ENGINE MANAGEMENT 9

Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valves

UNIT V VEHICLE MANAGEMENT SYSTEMS 9

ABS system, its need, layout and working. Electronic control of suspension – Damping control, Electric power steering, Supplementary Restraint System of air bag system – crash sensor, seat belt tightening. Cruise control. Vehicle security systems- alarms, vehicle tracking system. On board diagnostics. Collision avoidance Radar warning system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. The student will be able to explain the various control strategies used in automotive electronics
2. The student will be able to explain the working principle of various sensors and its applications in automobiles
3. The student will be able to explain various principles involved in electronic engine management systems for Petrol engines
4. The student will be able to explain various principles involved in electronic engine management systems for diesel engines
5. The student will be able to explain the control system operation behind the function of various chassis management systems

TEXT BOOKS:

1. William B Ribbens "Understanding Automotive Electronics", SAE Publications, 1998
2. Eric Chowanietz "Automobile Electronics" SAE Publications, 1994

REFERENCE BOOKS:

1. Robert Bosch "Diesel Engine Management" SAE Publications, 2006
2. Robert Bosch, "Gasoline Engine Management" SAE Publications, 2006

OPEN ELECTIVES OFFERED BY THE DEPARTMENT OF BIOMEDICAL ENGINEERING

SI No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OBM1701	Anatomy and Physiology for Engineers	OE	3	3	0	0	3
2	OBM1702	Biomaterials and Artificial Organs	OE	3	3	0	0	3
3	OBM1703	Fundamentals of Medical Instrumentation	OE	3	3	0	0	3
4	OBM1704	Engineering Mechanics for Medical Applications	OE	3	3	0	0	3
5	OBM1705	Basics of Biosensors and Biophotonics	OE	3	3	0	0	3

OBM1701 ANATOMY AND PHYSIOLOGY FOR ENGINEERS L T P C
3 0 0 3

OBJECTIVES

- To identify all the organelles of an animal cell and their function.
- To understand structure and functions of the various types of systems of human body.
- To demonstrate their knowledge of importance of anatomical features and physiology of human systems

UNIT I BASICS OF HUMAN BODY 7

Cell: Different types of cell, Cell Structure and its organelles with functions. Cell Membrane –Transport across Cell Membrane -Membrane Potential – Origin and propagation of potential. Homeostasis. Tissues: Types and functions.

UNIT II SKELETAL AND MUSCULAR SYSTEM 8

Skeletal System: Structure and types of Bone and its functions – Types of joints and functions – Types of cartilage and functions – Introduction about implants. Muscular System: Types and functions of Muscles. Skin.

UNIT III CARDIOVASCULAR AND RESPIRATORY SYSTEM 11

Blood: Composition – Functions . Structure of heart – Conduction System of heart- ECG . Blood Vessels – Structure and types. Blood pressure and measurement. Respiratory system: Parts of respiratory system – Respiratory physiology – Lung volumes and capacities – Types of respiration.

UNIT IV NERVOUS AND SPECIAL SENSORY SYSTEM 10

Nervous: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – Brain: Parts of Brain –Reflex Mechanism –Autonomic Nervous systems and its functions-EEG. Sense Organs: Eye and Ear.

Unit V DIGESTIVE AND URINARY SYSTEMS 9

Digestive: Organs of Digestive system – Digestion and Absorption. Urinary System: Structure of urinary system, Kidney and Nephron – Mechanisms of Urine formation – Micturition reflex.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Students would be able to explain basic structure and functions of cell
- Students would have learnt about anatomy and physiology of various systems of human body
- Students would be able to explain interconnection of various systems

TEXT BOOK:

1. Elaine.N. Marieb , "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi

REFERENCES:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, "Fundamentals of Anatomy and Physiology". Tenth Edition, Pearson Publishers
2. Gillian Pocock, Christopher D. Richards, "The human Body – An introduction for Biomedical and Health Sciences", Oxford University Press, USA
3. William F.Ganong, "Review of Medical Physiology", 22nd Edition, Mc Graw Hill, New Delhi.
4. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", 2nd edition, W.B. Saunders Company
5. Guyton & Hall, "Medical Physiology", 13th Edition, Elsevier Saunders

OBM1702	BIOMATERIALS AND ARTIFICIAL ORGANS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn characteristics and classification of Biomaterials.
- To understand different metals and ceramics used as biomaterials.
- To study the different polymeric materials.
- To know the different types of soft and hard tissue implants.
- To learn artificial organ developed using these biomaterials.

UNIT I INTRODUCTION TO BIO-MATERIALS 9

Definition and classification of bio-materials, Characterization of biomaterials: mechanical properties, surface properties, wound healing process, body response to implants, blood compatibility.

UNIT II METALLIC AND CERAMIC MATERIALS 9

Metallic implants : Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy. Ceramic implant: bioinert, biodegradable or bio resorbable, bioactive ceramics, applications of ceramic and metallic implants.

UNIT III POLYMERIC IMPLANT MATERIALS 9

Polymerization, factors influencing the properties of polymers, polyamides, Acryrilic polymers, rubbers, high strength Thermoplastic, Bio polymers: Collagen and Elastin, Medical Textiles: Silica, Chitosan, PLA composites, medical applications.

UNIT IV TISSUE REPLACEMENT IMPLANTS 9

Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, Internal fixation device, joint replacements.

UNIT V ARTIFICIAL ORGANS 9

Artificial blood, Artificial skin, Artificial Heart, Cardiac pacemaker, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyser membrane), Dental Implants.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Analyze different types of Biomaterials and its classification.
2. Identify metals and ceramic implants used for medical applications
3. Compare different types of synthetic and bio polymers as biomaterials.
4. Perform combinations of materials that could be used as a tissue replacement implant.
5. Explain the working of heart lung machine, dialysis unit and other artificial organs.

TEXT BOOKS:

1. Sujata V. Bhatt, "Biomaterials", Second Edition, Narosa Publishing House, 2005.
2. Park J.B, R.SLakes "Biomaterials An Introduction", Springer, 2007.

REFERENCES:

1. Joseph D Bronzino, "Biomedical engineering Fundamentals", CRC press, Third Edition,2006.
2. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,"Woodhead Medical Textiles and Biomaterials for Healthcare", Publishing Limited 2006.
3. Andrew F.VonRacum, "Handbook of Biomaterials Evaluation: Scientific, Technical and Clinical Testing of Implant Materials", Second Edition, CRC Press, 1998.
4. BD Ratner, AS Hoffmann,FJ Schoen, JE Lemmons, "An Introduction to Materials in Medicine" Academic Press, Third Edition, 2013

OBM1703	FUNDAMENTALS OF MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the methods of recording various bio potentials
- To study how to measure biochemical and various physiological information
- To understand the working of units which will help to restore normal functioning of human
- To understand the use of radiation for diagnostic and therapy
- To understand the need and technique of electrical safety in Hospitals

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

The origin of Bio-potentials; biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, EOG, lead systems and recording methods, typical waveforms and signal characteristics.

UNIT II BIOCHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT 9

PH, PO2, PCO2, PHCO3, Electrophoresis, colorimeter, photometer, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood cell counters.

UNIT III ASSIST DEVICES AND BIO-TELEMETRY 9

Cardiac pacemakers, DC Defibrillator, Telemetry principles, frequency selection, Biotelemetry, radio-pill and tele-stimulation.

UNIT IV RADIOLOGICAL EQUIPMENTS 9

Ionising radiation, Diagnostic x-ray equipments, use of Radio Isotope in diagnosis, Radiation Therapy.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Thermograph, endoscopy unit, Laser in medicine, Diathermy units, Electrical safety in medical equipment.

TOTAL: 45 PERIODS

OUTCOMES:

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

- To analyze the methods of recording various bio potentials.
- To measure biochemical and various physiological information.
- To develop working units which will helps to restore normal functioning of human.
- To identify the appropriate radio isotope in diagnosis.
- To apply electrical safety procedures in Hospitals.

TEXT BOOK

1. Leislie Cromwell, "Biomedical instrumentation and measurement", Prentice Hall of India, New Delhi, 2007.

REFERENCES

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA McGraw-Hill, NewDelhi, 2003.
2. Joseph J.Carr and John M.Brown, "Introduction to Biomedical equipment Technology", John Wiley and Sons, New York, 2004.

OBM1704	ENGINEERING MECHANICS FOR MEDICAL APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the fluid mechanics.
- Learn the mechanics of physiological systems.
- Be familiar with the mathematical models used in the analysis of biomechanical systems.
- Be exposed to the advancements in biomechanics.

UNIT I BIO-FLUID MECHANICS 9

Newton's laws, Stress, Strain, Elasticity, Hooks-law, viscosity, Newtonian fluid, Non-Newtonian fluid, Viscoelastic fluids, vascular tree, Relationship between diameter, velocity and pressure of blood flow, Resistance against flow. Bioviscoelastic fluid: Viscoelasticity - Viscoelastic models, Maxwell, Voight and Kelvin Models, Response to Harmonic variation, Use of viscoelastic models, Bio- Viscoelastic fluids: Protoplasm, Mucus, Saliva, Synovial fluids.

UNIT II CARDIAC MECHANICS 9

Cardiovascular system. Mechanical properties of blood vessels: arteries, arterioles, capillaries and veins. Blood flow: Laminar and Turbulent, Physics of cardiovascular diseases, Prosthetic heart valves and replacements. Respiratory Mechanics: Alveoli mechanics, Interaction of Blood and Lung P-V curve of Lung: Breathing mechanism, Airway resistance, Physics of Lung diseases.

UNIT III SOFT TISSUE MECHANICS 9

Pseudo elasticity, non-linear stress-strain relationship, Viscoelasticity, Structure, function and mechanical properties of Cartilage, Tendon, Ligament and skin.

UNIT IV MECHANICS OF JOINTS 9

Structure, composition and mechanical properties of bone, types of joints, kinetics and kinematics of joints, lubrication of joints.

UNIT V MODELLING 9

Introduction to Finite Element Analysis, Analysis of bio mechanical systems using Finite element methods, Graphical design. Mathematical models, blood vessel modeling – windkessel model, pulse wave velocities in arteries, determination of in-vivo elasticity of blood vessel.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the mechanics of physiological systems.
- Solve the dynamics and fluid mechanics problems.
- Analyze the biomechanical systems.
- Design orthopaedic applications.

TEXT BOOKS:

1. Y.C Fung, "Biomechanics- Mechanical properties of living tissues", 2nd Edition, Springer-Verlag, 1993.
2. Jay D. Humphrey, Sherry De Lange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design" , Springer Science+Business Media, 2004.

REFERENCES:

1. Susan J. Hall, "Basic Biomechanics" 6th edition, Mc Graw Hill Company, 1953.
2. C. Ross Ethier and Craig A. Simmons, Cambridge University Press, 2007.

OBM1705 BASICS OF BIOSENSORS AND BIOPHOTONICS L T P C
3 0 0 3

OBJECTIVES

- Learn bioelectric phenomenon
- Understand the optical properties of tissues
- Learn measurement and instrumentation technique for biological applications

UNIT I ORIGIN AND MEASUREMENT OF BIOPOTENTIAL 9

Bioelectricity and bioelectric phenomenon, electrical activities of cells and neurons, Signal transduction mechanism, equivalent circuit model for cell membrane, biopotential measurements-surface, needle and micro electrodes, Bio-amplifier, electrical properties of tissues (R, ε and μ),

UNIT II TECHNIQUES AND TYPES OF BIOSENSORS 9

Overview about technologies for detection of biochemical species – using enzymes, antibodies and antigen, applications of DNA chips, molecular recognition, lab-on-chip, Biosensors as Functional Analogs of Chemoreceptors, Structure and Function of Transducers, Thermometric Indication with Thermistors, Optoelectronic Sensors, Piezoelectric Sensors, Electrochemical Sensors, Amperometric Electrodes, Effects in Biosensors.

UNIT III OPTICAL PROPERTIES OF THE TISSUES `9

Refraction, Scattering, Absorption, Light transport inside the tissue, Tissue properties, Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical-Thermal-Electromechanical – Photo ablative processes.

UNIT IV INSTRUMENTATION IN PHOTONICS 9

Instrumentation for absorption, Scattering and emission measurements, excitation light sources – high pressure arc lamp, LEDs, Lasers, Optical filters, - optical detectors – Time resolved and phase resolved detectors.

UNIT V LASERS IN MEDICINE 9

Introduction, Laser physics, medical lasers, Laser interaction with tissue, application of Lasers in Diagnosis and Imaging, Laser surgery and therapy, thermal interaction between laser and Tissue. Integrated laser-fiber systems and their applications in medicine - cardiovascular disease, Gastroenterology, thoracic surgery, Neurosurgery and Oncology, Laser safety fundamentals

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design simple electrodes for biopotential measurement
- Design biosensors for any real time problem
- Relate optical properties of tissues for real time problems
- Use different standard laboratory instruments
- Explain special techniques of laser

TEXT BOOKS:

1. Paras N. Prasad, "Introduction to Biophotonics", A. John Wiley and Sons, Inc. Publications, 2003
2. Banica F.G., Chemical sensors and biosensors: Fundamentals and applications, Wley 2012
3. Bard A.J., Faulkner, "Electrochemical Methods: Fundamentals and Applications", 2nd Ed., Wiley, 2001

REFERENCES:

1. Markolf H. Niemz, Laser-Tissue Interaction Fundamentals and Applications, Springer, 2007.
2. Leslie Cromwell, Biomedical Instrumentation and measurement, Prentice hall of India, New Delhi, 2007.

OPEN ELECTIVE OFFERED BY DEPT OF BIOTECHNOLOGY

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OBT1701	Basic Bioinformatics	OE	3	3	0	0	3
2	OBT1702	Biotechnology in Product Development	OE	3	3	0	0	3
3	OBT1703	Food and Nutrition	OE	3	3	0	0	3
4	OBT1704	Medical Sciences for Engineers	OE	3	3	0	0	3
5	OBT1705	Application of Biotechnology for Environmental protection	OE	3	3	0	0	3
6	OBT1706	Fermentation Technology	OE	3	3	0	0	3

OBT1701 BASIC BIOINFORMATICS L T P C
3 0 0 3

COURSE OBJECTIVES

This course aims to develop the skills of the students in Bioinformatics. At the end of this course, the students would have learnt about tools used in Bio informatics & how to use them.

UNIT I INTRODUCTION 9

Basic UNIX commands – telnet – ftp – protocols – hardware – topology -search engines – search algorithms – R/python programming.

UNIT II DATABASES 9

Data management – data life cycle – database technology – interfaces and implementation – different biological databases and their uses

UNIT III SEQUENCE ALIGNMENT, PATTERN MATICHING AND STATISTICAL METHODS 9

Pairwise sequence alignment – local vs. global alignment – multiple sequence alignment – dot matrix analysis – substitution matrices – dynamic programming – bayesian methods – tools – BLAST – FASTA- machine learning – neural networks – statistical methods – Hidden Markov models

UNIT IV PHYLOGENY 9

Introduction; mutations; irrelevant mutations; controls; mutations as a measure of time; distances; reconstruction; distances between species; estimating time intervals from distances.

UNIT V ADVANCED TOPICS IN BIOINFORMATICS 9

Concept of Central Dogma, Gene, Genome, Proteome, Pathway, Gene Expression Data. Examples of high throughput data analysis and data visualisation. Scatter plots ,Heat maps.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The students will be able to

- Retrieve biological information from databases and analyse them.
- Gain knowledge regarding evolution of protein and nucleotide sequences.
- Use machine learning techniques to understand protein interactions and microarray data.

TEXT BOOKS

1. B. Bergeron, Bioinformatics Computing, PHI, 2002.
2. Westhead, D.R., Parish, J.H., Twyman, R.M., Instant Notes In Bioinformatics, BIOS Scientific Publishers, 2000.

REFERENCE BOOKS:

1. C. Gibas & P. Jambeck, Developing Bioinformatics Skills, O'Reilly, 1999.

OBT1702 BIOTECHNOLOGY IN PRODUCT DEVELOPMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To make the students gain knowledge about Biotechnology products.
- To create the mindset in the start-up of Biotech companies.
- To learn about bioethical issues in developing and marketing biotech products to the public.

UNIT I OVERVIEW OF BIOTECHNOLOGY INDUSTRIES 8

Scope - Biotechnology Industries in India and Abroad - Fundamentals of Biotechnology for business - Trends and key issues in Biotechnology, Technology basis in industrial segment, emerging technologies and technical convergences issues.

UNIT II NEW VENTURE CREATION 10

Entrepreneurship Plant tissue culture lab construction – Equipment, glassware and chemical requirements - techniques in culturing of plants. Export of tissue cultured plants to aboard – Vermitechnology – Mushroom cultivation - single cell protein - Biofertilizer technology and production - Commercialization of R&D - Fermentation technology: Bakery, Dairy products.

UNIT III PRODUCT DEVELOPMENT 9

Beer, wine and ethanol production using different sources– Enzyme: production, purification and characterization - Organic acids (Citric, lactic) production - Antibiotic production - Biogas technology - Azolla cultivation, biocement - Product development and project management, transition from R&D to business units. Institute– industry interaction and partnership/ alliances.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

Bioethics and Legal Issues - Intellectual property rights in Biotech, Patent laws - Bioethics and current legal issues - Marketing and public perceptions in product development – Genetically modified products and organisms (Transgenic products), Technology licensing and branding concerns.

NIT V BUSINESS PLANS FOR BIOTECHNOLOGISTS 9

Healthcare, Biomedical Sciences, Agriculture and Agrobiotechnology. Transfer and business planning - Bank loan and finance strategy – Budget plan – licensing and Branding Concerns and Opportunities, Policy and regulatory Concerns and Opportunities. Financial assistance for R&D projects and entrepreneurship. Corporate partners marketing – Model project: Case studies of different industries and their strategic planning.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course students will be able to

- Know various areas of biotechnology industries in India and abroad based on industry segment.
- Develop new venture procedures for promoting entrepreneurship in biotechnology.
- Produce and commercialize various bioproducts from R&D to business units.
- Analyze business plans and financial strategies for bio-based industries and its regulatory concerns.partners marketing – Model project: Case studies of different industries and their strategic planning.

TEXT BOOKS:

1 Richard Oliver. “The coming Biotech age: The business of Biomaterials”, McGraw Hill Publications, New York, USA, 2000.

2 Karthikeyan, S. and Arthur Ruf,. “Biobusiness”. MJP Publications. Chennai, India. 2009.

REFERENCES:

1 Ruth Ellen Bulger. “The ethical dimensions of the Biological sciences: Cambridge University Press”. New York. 1993.

2 Gurinder Shahi. “BioBusiness in Asia: How countries Can Capitalize on the Life Science Revolution” Pearson Prentice Hall, 2004.

3 Cynthia Robbins., “The business of Biotechnology”, UK, HarperCollins, 2001.

OBT 1703 FOOD AND NUTRITION

L	P	T	C
3	0	0	3

COURSE OBJECTIVES:

1. To introduce the students to the principles of Human Nutrition.
2. To understand the importance of food for healthy living.
3. To familiarize with food related hazards and food hygiene.

UNIT 1 INTRODUCTION TO NUTRITION 9

Development of Nutrition as a Science - Definition of Nutrition - Undernutrition over nutrition and malnutrition. Dietary fibre and its importance, Sources of soluble and insoluble fibre, Carbohydrates, simple and complex sugars, Carbon loading, Fats, saturated, PUF and MUF, Cholesterol, HDL, LDL, and VLDL, Optimal calciumrequirements, and bone banking, Phyto chemical and antioxidants, exercise and free radicals, role of antioxidants in preventing damage and recovery time, Selenium and Vitamin C deficient diet, Iron and Performance Nutrition.

UNIT II PROTEINS, MICRONUTRIENTS AND NUTRITIONAL SUPPLEMENTS 9

Composition - structure and classification, function of protein, Amino acids Indispensable and dispensable amino acids - special function of amino acids - protein deficiency - Protein Energy Malnutrition - KWASHIORKOR and MARASUMS - etiology, clinical features, treatment and prevention - Evaluation of protein quality - PER, BV, NPU and NPR, chemical score mutual and amino acid supplementation of proteins.

Vitamins - dietary sources and deficiency manifestations. Minerals – Sources and importance Nutritional supplements – Neutraceuticals antioxidants, omega 3 fatty acids. Multivitamins – Benefits and adverse effects.

UNIT III FOOD AND ENERGY 9

Energy units, Determination of energy requirements, Specific dynamic action of food (Thermogenic food in REE), Basal metabolism - definition, determination -factors affecting BMR - energy requirements for various types of activities- recommended allowances, Indian diets - Energy requirements for different age groups.

UNIT IV REGULATION OF FOOD CONSUMPTION 9

The factors that mediate the sensation of hunger and satiety on the level of the central nervous system. Central and peripheral mechanisms that are involved in the regulation of food consumption. The correlation between changes that have occurred over recent decades, such as increases in the consumption of fast food, snack foods, sugary beverages and fructose, and impairment in the regulation of food consumption.

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, insecticides and microbes; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

- Understand the importance of food and nutrition in human health.
- Apply the concepts of energy related to food.
- Analyze the role of CNS in regulation of hunger, satiety and food consumption.

- Evaluate food related hazards and their prevention.
- Create and innovate hygienic food suitable for all ages.

TEXT BOOKS:

1. Guthrie H.A. - Introductory Nutrition C.V. Mosby Co. St. Louis.

2. M. Swaminathan "Principles of Nutrition and Dietectics", 1993, Bappeo 88, Mysore Road, Bangalore - 560 018.

REFERENCE BOOKS:

1. Bogert, J.G.V, Briggs, DR Calloway Nutrition and physical fitnes, 11th edition - 1985 - W.B. Saunders Co., Philadelphia, London, Toranto.

2. William, S.R. - Nutrition and Diet Therapy (1985) 5th edition, Mosbey Co. St. Louis

3. Maurice E. Shils, James A. Olson, Moshe Shike "Modern Nutrition in health and disease" eighth edition, Vol. I & II Lea & Febiger Philadelphia, Awaverly Company, 1994.

OBT1704 MEDICAL SCIENCE FOR ENGINEERS L T P C
3 0 0 3

OBJECTIVES:

- To create awareness among students about the various lifestyle diseases.
- To enable the students to create a consciousness on stress management
- To develop the knowledge of students on the clinical symptoms and molecular mechanism of common diseases.

UNIT 1 INTRODUCTION TO LIFESTYLE DISORDERS 9

Lifestyle disorders- causes, symptoms and management – obesity, diabetics, CVDs, Cancer, ulcer, stones etc., and their relation to living environment.

UNIT II RISK FACTORS AND DRUG ABUSE 9

Drug abuse and drug induced toxicities- hazards of smoking, alcohol and related diseases, self-medication.

UNIT III HEALTHY LIVING 9

Importance of balanced diet, adequate water intake, mental health – stress and how to overcome stress. Importance of antioxidants. PUFA, EAA and EFA in diet, exercise, yoga.

UNIT IV PREVENTION AND MANAGEMENT OF COMMON ILLNESS 9

Clinical Symptoms of common illness, their prevention and management (eg. Common cold, dehydration, food poisoning etc.,).

UNIT V MOLECULAR MECHANISM 9

Basic molecular mechanism - etiology and treatment of common diseases. Discussion and brain storming sessions with specific case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

- Understand the lifestyle disorders and diseases.
- Handle stress and how to manage.
- Understand clinical symptoms and molecular mechanism of common diseases.

TEXT BOOKS:

1. Guide to prevention of lifestyle diseases- M.N. Kumar, R.Kumar, Deep & Deep Publications, ISBN: 817629518.
2. Textbook of Biochemistry: With Clinical Correlations by Thomas M. Devlin, 7th edition, John Wiley &son inc.

REFERENCES

1. The BASIC – Strategies for coping with stress and building personal resilience for physicians. OMA. http://php.oma.org/PDF%20files/The%20Basics/TheBasics-full%20version.pdf
2. The health consequences of smoking—50 years of progress: a report of the Surgeon General. U.S. Department of Health and Human Services, 2014.http://www.surgeongeneral.gov/library/reports/50-years-of-progress/exec-summary.pdf

OBT1705 APPLICATION OF BIOTECHNOLOGY FOR ENVIRONMENTAL PROTECTION

L	T	P	C
3	0	0	3

OBJECTIVES

To enable the students

- Gain sound knowledge about the scientific and engineering principles of microbiological treatment technologies to clean up contaminated environments and to generate valuable resources for the human society.
- Have indepth knowledge about Conventional treatment methodologies that can be replaced with the advancements in biotechnological field such as molecular biology and genetic engineering strategies.
- Study the ways for the alternate sources of energy to avoid environmental issues.

UNIT I 9

Microbial flora of soil, Ecological adaptations, Interactions among soil microorganisms, biogeochemical role of soil microorganisms. Biodegradation, Microbiology of degradation and its

mechanism, Bioaugmentation, Biosorption, Bioleaching, Bioremediation- Types of Bioremediation, Bioreactors for Bioremediation, Metabolic pathways for Biodegradation for specific organic pollutants.

UNIT II **9**

Pollution- Sources of pollutants for Air, Water, and Land and its characteristics- Environmental monitoring & sampling - Air pollution- control. Modes of Biological treatment methods for wastewater- aerobic digestion, anaerobic digestion, Anoxic digestion, the activated sludge process, Design and modeling of activated sludge processes, Aerobic digestion, Design of a trickling biological filter, Design of anaerobic digester.

UNIT III **9**

Industrial waste management- Dairy, Paper & Pulp, Textile, leather, hospital and pharmaceutical industrial waste management, e-waste- radioactive and nuclear power waste management- Solid waste management.

UNITIV **9**

Molecular biology tools for Environmental management, rDNA technology in waste treatment, Genetically modified organisms in Waste management, Genetic Sensors, Metagenomics, Bioprospecting, Nanoscience in Environmental management, Phytoremediation for heavy metal pollution, Biosensors development to monitor pollution.

UNIT V **9**

Alternate Source of Energy, Biomass as a source of energy, Biocomposting, Vermiculture, Biofertilizers, Organic farming, Biofuels, Biomineralization, Bioethanol and Biohydrogen, Bioelectricity through microbial fuel cell, energy management and safety.

TOTAL : 45 PERIODS

COURSE OUTCOMES

Upon completion of the course the students will know

1. The microbial flora, bioremediation and biodegradation of organic pollutants.
2. Various types of pollution, its control and management.
3. Waste management in various industries like dairy, paper, textile and solid waste management.
4. Molecular biology tools for Environmental protection.
5. Alternate sources of energy to avoid environmental issues.

TEXT BOOKS

1. Environmental Biotechnology by Alan Scragg (1999); Longman.

2. Chakrabarty K.D., Omen G.S., Biotechnology And Biodegradation, Advances In Applied Biotechnology Series, Vol.1, Gulf Publications Co., London, 1989.

3. Waste water Engineering Treatment, Disposal and Reuse. Metcalf & Eddy (1991) McGraw Hill.

4. Environmental Biotechnology, Forster, C. F and Waste, D.A. J. (1987) Ellis Horwood Halsted Press.

5. Biochemical Engineering Fundamentals 2nd Ed. Bailey, J. E. and Ollis, D. F. (1986) Mac Graw Hill, New York.

REFERENCES

1. Stanier R.Y., Ingraham J.L., Wheelis M.L., Painter R.R., General Microbiology, Mcmillan Publications, 1989.

2. New Processes of Waste water treatment and recovery. G.Mattock E.D. (1978) Ellis Horwood.

3. Environmental Biotechnology, Jogdand, S.N. (1995) Himalaya Publishing House, New Delhi.

OBT1706 FERMENTATION TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge on design and operation of fermentation processes with all its prerequisites.
- To learn the production of primary and secondary metabolites for various industrial applications.
- To instruct the important concepts in fermentation engineering.

UNIT I OVERVIEW OF FERMENTATION PROCESSES 9

Basic configuration of fermentor and ancillaries, General requirements of fermentation processes, main parameters to be monitored and controlled in fermentation processes. Methods of Fermentation: Batch, Fed Batch and Continuous. Types of fermenters.

UNIT II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 9

Criteria for good medium, medium requirements for fermentation processes, Types of medium, medium formulation of optimal growth and product formation, design of various commercial media for industrial fermentations, medium optimization methods.

UNIT III STERILIZATION KINETICS 6

Thermal death kinetics of microorganisms, heat sterilization of liquid media, filter sterilization of liquid media, design of sterilization equipment- batch and continuous.

UNIT IV PRODUCTION OF PRIMARY AND SECONDARY METABOLITES 12

Product Recovery: Sedimentation, Centrifugation, Filtration, Precipitation, Chromatography, and Crystallization. Organic feed stocks produced by Fermentation – Ethanol, Organic acids (Citric acid and Lactic acid), Amino acids – L-Glutamic acid and Tryptophan. Mechanism of secondary metabolite production,Antibiotics (Penicillin, Cephalosporin), Vitamins (Vitamin B12, Riboflavin).

UNIT V MODERN FERMENTATION TECHNOLOGY 9

Microbial fungicides and Pesticides, Chemicals and Pharmaceuticals made by fermentation, Biopolymers. Microbial leaching, Fermentation economics and its calculations,Future of fermentation technology, Case Study on any two fermented products.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course graduates will be able to

- Determine the substrates used for industrial fermentation process
- Differentiate the various product recovery techniques
- Investigate the applications of primary and secondary metabolites
- Design the flow chart of fermentation economics and its calculations

TEXT BOOKS

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.

2. Doran, Pauline "of Bioprocess Engineering Principles ". Elsevier, 1995.
3. Presscott, D. "Industrial Microbiology", CBS Publishers, New Delhi. 1999.

REFERENCES

1. Shuler, Michael L. and Fikret Kargi, " Bioprocess Engineering ", Prentice Hall, 1992.
2. Bailey, James E. and David F. Ollis, " Biochemical Engineering Fundamentals", IInd Edition. McGraw Hill , 1986.

3. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
4. Irwin H.Segel, Biochemical Calculations, John Wiley & Sons, 2nd Edition, Wiley Publishers, New Delhi.

OPEN ELECTIVE OFFERED BY DEPT OF CHEMICAL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OCH1701	Introduction to Fertilizer Technology	OE	3	3	0	0	3
2	OCH1702	Introduction to Petroleum Technology	OE	3	3	0	0	3
3	OCH1703	Unit operations in Environmental Engineering	OE	3	3	0	0	3
4	OCH1704	Process Technology	OE	3	3	0	0	3
5	OCH1705	Petrochemical Processing	OE	3	3	0	0	3
6	OCH1706	Recent trends in water treatment	OE	3	3	0	0	3

OCH1701 INTRODUCTION TO FERTILIZER TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

To enable the students to learn the fertilizer manufacturing including new or modified fertilizer products and new techniques.

UNIT I NITROGENOUS FERTILISERS 9

Introduction about fertilizers and uses, Methods of production of nitrogenous fertilizer-ammonium sulphate,urea and calcium ammonium nitrate, characteristics and specifications, storage and handling.

UNIT II PHOSPHATIC FERTILISERS 9

Raw materials and processes for the production of sulphuric and phosphoric acids; phosphates fertilizers –single superphosphate, triple superphosphate, and their methods of production, characteristics and specifications.

UNIT III POTASSIC FERTILISERS 9

Methods of production of potassium chloride, potassium schoenite, their characteristics and specifications.

UNIT IV COMPLEX AND NPK FERTILISERS 9

Methods of production of ammonium phosphate, mono-ammonium phosphate, diammonium phosphate, nitrophosphates, superphospates

UNIT V MISCELLANEOUS FERTILISERS 9

Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilizers, control release fertlisers.

TOTAL : 45 PERIODS

OUTCOME:
At the end of this course, the students would know about the manufacturing techniques of fertilizers and design the equipments in fertilizer industry

TEXT BOOKS:
1. "Handbook of fertilizer technology", Association of India, New Delhi, 1977.
2. Menno, M.G.; "Fertilizer Industry - An Introductory Survey", Higginbothams Pvt. Ltd., 1973.

REFERENCES:
1. Sauchelli, V.; "The Chemistry and Technology of Fertilizers", ACS MONOGRAPH No. 148, Reinhold Publishing Cor. New York, 1980.
2. Fertiliser Manual, "United Nations Industrial Development Organisation", United Nations, New York, 1967.
3. Slack, A.V.; Chemistry and Technology of Fertilisers, Interscience, New York, 1966.

OCH1702 INTRODUCTION TO PETROLEUM TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:
To make the students understand petroleum engineering principles, their application to petroleum and natural gas manufacturing problems.

UNIT I INTRODUCTION 12
Introduction to petroleum industry, Refinery products – Refinery Feeds – Crude distillation – Coking and thermal process.

UNIT II CATALYTIC CRACKING 9
Catalytic Cracking – Catalytical- hydro cracking – Hydroprocessing

UNIT III REFORMATION 9
Reforming and isomerization, alkylation and polymerization

UNIT IV LUBRICIATION 6
Lubriciating- oil blending- stocks -petrochemical feedstocks.

UNIT V COST EVALUATION 9
Cost Evaluation – Economic evaluation of petroleum reused and refineries.

TOTAL : 45 PERIODS

OUTCOME:
On completing this course, the students will be able to understand the concepts of catalytic cracking lubricating used by the oil and gas production technician today.

TEXT BOOKS:
1. Petroleum Refining : Technology and economics CRC Press V Edition 2007J.CH Garry , Hardward G.E and M.J.Kaiser.
2. Modern Petroleum Technology Upstream Vol I A.G. Lucas Hurley Edition 2002

REFERENCES:

1. Dryden, C.E., "Outlines of Chemical Technology", Edited and Revised by Gopala Rao. M. and M.Sitting, Second edition, Affiliated East-West press, 52, 1993.

OCH1703 UNIT OPERATIONS IN ENVIRONMENTAL ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

To make the students understand environmental problems, various techniques, equipment available in treatment of environmental issues.

UNIT I PRIMARY UNIT OPERATIONS 9

Selection of unit operations involved in primary treatment -Screening – Mixing - Neutralization - Coagulation and Flocculation – Flow equalization.

UNIT II SEDIMENATION AND FLOATION 9

Sedimentation - Type of settling – Construction and working – Clarifier-thickener- Column flotation-air flotation.

UNIT III FILTRATION 9

Filtration – classification of filters-Head loss through filters– Construction and Working.

UNIT IV ADSORPTION 9

Precipitation techniques - Adsorption - Activated carbon - Isotherms – Disinfection – Dechlorination.

UNIT V BIOLOGICAL UNIT OERATIONS 9

Kinetics of Biological growth - Suspended and attached growth processes - Aerobic and Anaerobic Treatment process.

TOTAL : 45 PERIODS

OUTCOME:

On completing this course, the students will be able to understand the concepts of various physical processes involved in waste treatment, construction and working of equipment and techniques.

REFERENCES

1. Metcalf & Eddy, "Wastewater Engineering - Treatment, Disposal, and Reuse ", Fourth Edition, Tata McGraw-Hill, 1995.
2. Casey. T.J. "Unit Treatment Processes in Water and Wastewater Engineering ", John Wiley & Sons, 2006.
3. Peavy H.S., Rowe D.R. and Tchobanoglous G. "Environmental Engineering", Tata Mc. Graw Hill, 1985.

OCH1704 PROCESS TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

To impart knowledge on various aspects of production engineering and enable the students to understand the practical methods of production in a chemical factory

UNIT I CHLOR ALKALI INDUSTRIES, SULPHURIC ACID MANUFACTURE 9

Flow charts and standard symbols used for devices, industrial safety and pollution, Manufacture of Soda ash, chlorine and caustic soda, sulphur trioxide and sulphuric acid

UNIT II CEMENT AND NITROGEN INDUSTRIES 9

Types and manufacture of Portland cement, Manufacture of glasses, Synthetic ammonia, Nitric acid, Urea

UNIT III FERTILIZER INDUSTRIES 9

Growth elements, functions, phosphoric acid, ammonium phosphate, potassium chloride, single, triple super phosphate introduction to pesticides, herbicides and bio-fertilizers.

UNIT IV ORGANIC INDUSTRIES 9

Manufacture of paper from pulp, Manufacture of Raw and refined sugar, extraction methods of oils, hydrogenation of oils, Petroleum refining, physical and chemical conversion products

UNIT V POLYMER INDUSTRIES 9

Manufacture of Nylon 6. 6., manufacturer of Cellulosic Fibres – Viscose Rayon, Polymerization processes – different types -Natural rubber; Synthetic rubber such as SBR, manufacture of films - cellulose Acetate, PVC.

TOTAL : 45 PERIODS

OUTCOME:

Student to integrate various courses and to give the young engineers some comprehension on various fields of production into which he will enter or with which he will be affiliated during the course of study or after completion of the study

TEXTBOOKS:

1. “Shreve's Chemical Process Industries Handbook”, Fifth Edition, McGraw-Hill 1998.
2. Dryden, C.E., “Outlines of Chemical Technology”, Edited and Revised by Gopala Rao. M. and M. Sitting, Second edition, Affiliated East-West press,52, 1993.

REFERENCES

1. Shukla and G.N. Pandey “Text book on Chemical Technology”, Vikas publishing company 1997.
2. Srikumar Koyikkal,”Chemical Process Technology and Simulation”, PHI Learning Ltd (2013).

OCH1705 PETROCHEMICAL PROCESSESING L T P C
3 0 0 3

OBJECTIVE:
To impart knowledge on different types of petrochemicals

UNIT I FIRST GENERATION PETROCHEMICALS I 9
Alternate routes with flow diagram for production of methane, ethane, propane, ethylene, propylene, butylenes, acetylene, naphthalene. Chemicals from methane, ethane, propane, ethylene, propylene, butylenes, acetylene.

UNIT II FIRST GENERATION PETROCHEMICALS II 9
Alternate routes with flow diagram for production of butadiene, related dienes, aromatics – Benzene, toluene, xylene – Chemicals from butadiene, related dienes, aromatics –Benzene, toluene, xylene.

UNIT III SECOND GENERATION PETROCHEMICALS 9
Alternate routes with flow diagram for production of ethylene glycol, VCM, acrylonitrile, phenol, caprolactum, adipic acid , hexamethylene diamine, DMT , TPA, maleic anhydride, styrene.

UNIT IV THIRD GENERATION PETROCHEMICALS I 9
Polymerization – Modes and techniques – Production of polyethylene – LDPE, HDPE, polypropylene, poly butadiene rubber, SBR, polystyrene, SAN, ABS.

UNIT V THIRD GENERATION PETROCHEMICALS II 9
Polyacrylonitrile, polyvinyl chloride, polycarbonates, nylon 6, nylon 66, polyesters, formaldehyde resins, explosives, dyes.

TOTAL : 45 PERIODS

OUTCOME:
Upon completion of this course, the students will know the sources and production methods of petrochemicals and the methods of manufacture of different petrochemicals from additives to electronic chemicals.

TEXT BOOKS:
1. Bhaskara Rao, B.K., “A Text on Petrochemicals”, Khanna Publishers, 2000.
2. Sukumar Maiti, “Introduction to Petrochemicals”, 2nd Edition, Oxford and IBH Publishers, 2002.

REFERENCES:
1. Margaret Wells, “Handbook of Petrochemicals and Processes”, 2nd Edition, Ash Gate Publishing Limited, 2002.
2. Sami Matar, and Lewis F. Hatch., “Chemistry of Petrochemical Processes”, 2nd Edition, Gulf Publishing company, 2000.
3. Dryden, C.E., “Outlines of Chemical Technology”, 2nd Edition, Affiliated East-West Press, 1993.

OCH1706 RECENT TRENDS IN WATER TREATMENT L T P C
3 0 0 3

OBJECTIVE:
To impart knowledge on various water treatment techniques

UNIT I AOP PROCESS I 12
Advanced oxidation process – introduction – mechanism- photo oxidation reactions – photocatalytic reactions, photo initiated oxidation – UV- H_2O_2 / ozonation, fenton / photofenton – photocatalysis – light source choice – used in AOPs and their spectral distributions.

UNIT II AOP PROCESS II 12
HOMOGENOUS AOPs- Ozone, electro-chemical oxidation, ultrasonication, UV – Photolysis, Hydrogen Peroxide and Ultraviolet Radiation (H_2O_2/UV), chemical and non-chemical AOPs, advantages and disadvantages of homogeneous processes.

UNIT III MEMBRANE BIOREACTORS 12
MEMBRANE BIOREACTORS Introduction and Historical Perspective of MBRs, Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, Commercial Technologies, Case Studies

UNIT IV NATURAL COAGULATION 9
NATURAL COAGULANTS – applications – batch coagulation test – turbidity removal – dye removal – mechanism – survey – scale up, cost analysis and design.

TOTAL : 45 PERIODS

OUTCOME:
On completing this course, the students will be able to understand the latest advances in techniques various physical processes involved in waste treatment, construction and working of equipment and techniques.

REFERENCES

1. Simon Parsons, "Advanced oxidation processes for water and wastewater treatment", IWA Publishing, 2004
2. Thomas Oppenländer, "Photochemical Purification of Water and Air: Advanced Oxidation Processes (AOPs): Principles, Reaction Mechanisms, Reactor Concepts", Wiley-VCH Publishing, Published by, 2003
3. Symon Jud, MBR Book – "Principles and application of MBR in water and wastewater treatment", Elservier, 2006.
4. Yamamoto K. and Urase T, "Membrane Technology in Environmental management", special issue, Water Science and technology, Vol.41, IWA Publishing, 2000.
5. Radin Maya Saphira Radin Mohamed, Adel Al-Gheethi, Amir Hashim bin mohd kassim, "Application of Natural Coagulants for Wastewater Treatment", Integrated water resource protection, 2017.

OPEN ELECTIVES OFFERED BY DEPT OF CIVIL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCE1701	Disaster Management	OE	3	3	0	0	3
2.	OCE1702	Coastal Zone Management	OE	3	3	0	0	3
3.	OCE1703	Smart Structures and Smart Materials	OE	3	3	0	0	3
4.	OCE1704	Non Destructive Testing of Materials	OE	3	3	0	0	3
5.	OCE1705	Basics of Architecture	OE	3	3	0	0	3
6.	OCE1706	Global Warming and Climate Change	OE	3	3	0	0	3

OCE1701 DISASTER MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To acquire knowledge on hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment and Management, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

- Get familiarized with various disasters, causes and their impact on environment and society.
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Assess factors affecting vulnerabilities, differential impacts, impacts of major developmental projects, changes in land-use, climate change adaptation.
- Get familiarized with hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.
- Manage disaster, vulnerability assessment of buildings and infrastructure, case studies on coastal flooding, landslides, floods, forest fire, Manmade disasters and its mitigation.

TEXTBOOKS:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

OCE1702 **COASTAL ZONE MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn coastal zone components - coastal zone regulations, off shore coastal waters, estuaries, wetlands & lagoons.
- To acquire knowledge on wave dynamics - wave theory, wave energy, wave decay and wave force on structures
- To forecast waves and tides - SMB and PNJ methods, Darwin's equilibrium theory of tides, Effects on structures
- To understand coastal processes - Erosion and deposition, methods of shore protection, sea water intrusion and impact of sewage disposal in seas
- To understand the impact of waves on structures near coast, site selection for docks and harbours, dredging, types and selection of breakwaters and effects of mangrove forests to save coastal erosion.

UNIT I COASTAL ZONE 9

Coastal zone – Coastal zone regulations – Beach profile – Surf zone – Off shore – Coastal waters – Estuaries – Wet lands and Lagoons – Living resources – Non living resources.

UNIT II WAVE DYNAMICS 10

Wave classification – Airy's Linear Wave theory – Deep water waves – Shallow water waves – Wave pressure – Wave energy – Wave Decay – Reflection, Refraction and Diffraction of waves – Breaking of waves – Wave force on structures – Vertical – Sloping and stepped barriers – Force on piles.

UNIT III WAVE FORECASTING AND TIDES 9

Need for forecasting - SMB and PNJ methods of wave forecasting – Classification of tides – Darwin's equilibrium theory of tides – Effects on structures – seiches, Surges and Tsunamis.

UNIT IV COASTAL PROCESSES 8

Erosion and depositional shore features – Methods of protection – Littoral currents – Coastal aquifers – Sea water intrusion – Impact of sewage disposal in seas.

UNIT V HARBOURS 9

Structures near coast – Selection of site – Types and selection of break waters – Need and mode of dredging – Selection of dredgers – Effect of Mangalore forest.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

- Get familiarized with coastal zone components - coastal zone regulations, off shore coastal waters, estuaries, wetlands & lagoons.
- Analyze wave dynamics - wave theory, wave energy, wave decay and wave force on structures
- Forecast waves and tides - SMB and PNJ methods, Darwin's equilibrium theory of tides, Effects on structures
- Get familiarized with coastal processes - Erosion and deposition, methods of shore protection, sea water intrusion and impact of sewage disposal in seas

- Analyze the impact of waves on structures near coast, site selection for docks and harbours, dredging, types and selection of breakwaters and effects of mangrove forests to save coastal erosion.

TEXT BOOKS:

1. Richard Sylvester, "Coastal Engineering, Volume I and II", Elseiner Scientific Publishing Co., 1999
2. Quinn, A.D., "Design & Construction of Ports and Marine Structures", McGraw-Hill Book Co., 1999

REFERENCES:

1.Ed. A.T. Ippen, "Coastline Hydrodynamics", McGraw-Hill Inc., New York, 1993
2.Dwivedi, S.N., Natarajan, R and Ramachandran, S., "Coastal Zone Management in Tamilnadu".

OCE1703	SMART STRUCTURES AND SMART MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge on various materials and devices used for sensing distress.
- To acquire knowledge on various test methods for measuring strain due to the applied load
- To develop an understanding of the various sensors that can be used for structural health monitoring
- To obtain knowledge on the techniques and use of actuators, piezoelectric materials and shape memory alloys
- To develop an understanding on the principles and processes of various signal processing and control systems

UNIT I INTRODUCTION 9

Introduction to Smart Materials and Structures – Instrumented structures functions and response – Sensing systems – Self diagnosis – Signal processing consideration – Actuation systems and effectors.

UNIT II MEASURING TECHNIQUES 9

Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

UNIT III SENSORS 9

Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – The LVOT – Fiber optic Techniques.Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

UNIT IV ACTUATORS 9

Actuator Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magnetostructure Material – Shape Memory Alloys – Electro orheological Fluids– Electro magnetic actuation – Role of actuators and Actuator Materials.

UNIT V SIGNAL PROCESSING AND CONTROL SYSTEMS 9

Data Acquisition and Processing – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System – Linear and Non- Linear.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

- Get familiarized with various materials and sensing systems for diagnosing structural distress
- Get familiarized with the techniques to measure the strain on structures
- Indentify the use of appropriate sensors for distress diagnosis, interpret and analyze its results.
- Get familiarized with the techniques and use of actuators, piezoelectric materials and shape memory alloys
- Use signal processing and control systems for detecting structural response.

TEXT BOOKS

1. Brain Culshaw – Smart Structure and Materials Artech House – Borton. London-1996.

REFERENCES

1. L. S. Srinath – Experimental Stress Analysis – Tata McGraw-Hill, 1998.
2. J. W. Dally & W. F. Riley – Experimental Stress Analysis – Tata McGraw-Hill, 1998.

OCE1704 NON DESTRUCTIVE TESTING OF MATERIALS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.
- To acquire knowledge on various testing methods for detecting defects and for characterizing the material
- To obtain knowledge on various test methods using liquid penetration and Magnetisation methods for surface defect detection
- To know the techniques using principles of thermography and eddy current sensing elements
- To acquire knowledge on the principles and uses of ultrasonic testing methods and acoustic emission testing methods
- To develop an understanding on the principles, types and uses of radiography for NDT

UNIT I OVERVIEW OF NDT 7

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection V Unaided and aided.

UNIT II SURFACE NDE METHODS 8

Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing-

Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING(ET) 10

Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications.Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION(AE) 10

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique ¡VPrinciple, AE parameters, Applications.

UNIT V RADIOGRAPHY(RT) 10

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy-Xero-Radiography, Computed Radiography, Computed Tomography.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to

- Detect the manufacturing defects and characterize the materials
- Diagnose the surface defects using liquid penetration and magnetization methods
- Get familiarized with the principles of thermography and eddy current sensing elements and their use in NDT
- Get familiarized with the techniques and use of ultrasonic and acoustic emission testing methods
- Get familiarized with various radiographic techniques and use them for NDT.

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing¨, Narosa Publishing House, 2009.
2. Ravi Prakash, ¡§Non-Destructive Testing Techniques¡¨, 1st revised edition, New Age International Publishers, 2010

REFERENCES:

1. ASM Metals Handbook,¡¨Non-Destructive Evaluation and Quality Control¡¨, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, ¡§Introduction to Non-destructive testing: a training guide¡¨, Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier,¡§ Handbook of Nondestructive evaluation¡¨, McGraw Hill, New York 2001.
4. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.

OCE1705 **BASICS OF ARCHITECTURE** **L T P C**
3 0 0 3

OBJECTIVES:

- To acquire knowledge on the basics of Architectural design - introduction to basic elements, principles of design, integration of function and aesthetics.
- To know site planning, conduct site surveys, site analysis, to know layout regulations and layout design.
- To differentiate various building forms, apply anthropometry and space standards, to know building rules and regulations and its integration into building design
- To understand the climate so as to evolve an environmental responsive design of buildings.
- To know town planning, its concepts & processes, standards, zoning regulations, urban design and principles of landscape design.

UNIT I ARCHITECTURAL DESIGN **8**

Architectural Design – an analysis – integration of function and aesthetics – Introduction to basic elements and principles of design.

UNIT II SITE PLANNING **9**

Surveys – Site analysis – Development Control – Layout regulations- Layout design concepts.

UNIT III BUILDING TYPES **12**

Residential, institutional, commercial and Industrial – Application of anthropometry and space standards- Inter relationships of functions – Safety standards – Building rules and regulations – Integration of building services – Interior design

UNIT IV CLIMATE AND ENVIRONMENTAL RESPONSIVE DESIGN **8**

Man and environment interaction- Factors that determine climate – Characteristics of climate types – Design for various climate types – Passive and active energy controls – Green building concept.

UNIT V TOWN PLANNING **8**

Planning – Definition, concepts and processes- Urban planning standards and zoning regulations- Urban renewal – Conservation – Principles of Landscape design.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can be able to

- Get familiarized with the basics of Architectural design - introduction to basic elements, principles of design, integration of function and aesthetics.
- Use the basics of site planning, conduct site surveys, site analysis, to know layout regulations and layout design.
- To differentiate various building forms, apply anthropometry and space standards, to know building rules and regulations and its integration into building design.
- Get familiarized with the climate so as to evolve an environmental responsive design of buildings.
- Use the basic principles of town planning, its concepts & processes, standards, zoning regulations, landscape design in order to evolve an urban design.

REFERENCES:

1. Pramar. V.S. “Design fundamental in Architecture”, Somaiya Publications Pvt. Ltd., New Delhi, 1997.
2. Muthu Shoba Mohan.G.,”Principles of Architecture”., Oxford University Press., New Delhi, 2006.Rangwala. S.C. “Town Planning” Charotar Publishing House., Anand, 2005.
3. De Chiara.J., Michael. J. Crosbie.,”Time Saver Standards for Building Types”, McGraw Hill Publishing Company, New York, 2001.
4. Arvind Krishnan, Nick Baker, Simos Yannas, Szokolay.S.V., “Climate Responsive Architecture”.,
5. A Design Hand Book for Energy Efficient Building, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.
6. National Building Code of India., SP7 (Group 1) Bureau of Indian Standards, New Delhi, 2005.

OCE1706	GLOBAL WARMING AND CLIMATE CHANGE	L	T	P	C
		3	0	0	3

UNIT I EARTH’S CLIMATE SYSTEM 9

Role of ozone in environment-ozone layer-ozone depleting gases-Green House Effect, Radiative Effects of Greenhouse Gases-The Hydrological Cycle-Green House Gases and Global Warming – Carbon Cycle.

UNIT II - ATMOSPHERE AND ITS COMPONENTS 9

Importance of Atmosphere - Physical Chemical Characteristics of Atmosphere-Vertical structure of the atmosphere-Composition of the atmosphere-Atmospheric stability-Temperature profile of the atmosphere-Lapse rates-Temperature inversion-effects of inversion on pollution dispersion.

UNIT III - IMPACTS OF CLIMATE CHANGE 9

Causes of Climate change : Change of Temperature in the environment -Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT IV - OBSERVED CHANGES AND ITS CAUSES 9

Climate change and Carbon credits- CDM- Initiatives in India-Kyoto Protocol-Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India .

UNIT V - CLIMATE CHANGE AND MITIGATION MEASURES 9

Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS)- Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

TOTAL: 45 PERIODS

TEXT BOOK

1. Dash Sushil Kumar, "*Climate Change – An Indian Perspective*", Cambridge University Press India Pvt. Ltd, 2007.

REFERENCES

1. Adaptation and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press, Cambridge, 2006.
2. Atmospheric Science, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006.
3. Jan C. van Dam, Impacts of "*Climate Change and Climate Variability on Hydrological Regimes*", Cambridge University Press, 2003.

OPEN ELECTIVE OFFERED BY DEPT OF COMPUTER SCIENCE ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCS1701	Web Design and Management	OE	3	3	0	0	3
2.	OCS1702	Mobile Application Development	OE	3	3	0	0	3
3.	OCS1703	Fundamentals of Database	OE	3	3	0	0	3
4.	OCS1704	Web Programming with XML	OE	3	3	0	0	3
5.	OCS1705	IoT and its Applications	OE	3	3	0	0	3
6.	OCS1706	Programming in C	OE	4	2	0	2	3
7.	OCS1707	Programming in C++	OE	4	2	0	2	3
8.	OCS1708	Java Programming	OE	4	2	0	2	3
9.	OCS1709	Computer Programming	OE	4	2	0	2	3

OCS1701 WEB DESIGN AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- To understand basics of Dreamweaver.
- To learn web development in Dreamweaver.
- To learn content management.
- Be exposed to essentials of Joomla.
- To learn real world applications of Joomla.

UNIT – I INTRODUCTION TO DREAMWEAVER 9

Getting started - Installation - Dreamweaver workspace - Working with Dreamweaver sites - Working with Dreamweaver sites - Managing assets and libraries

UNIT – II HTML, CSS AND JAVASCRIPT 9

Creating pages with CSS - Laying out pages with HTML - Adding content to pages - Linking and navigation - Adding JavaScript behaviours.

UNIT – III CMS in DREAMWEAVER 9

Preparing to build dynamic sites - Understanding web applications- Installing a local web server - Setting up a data sources for web applications - Using database to store content - Collecting and Accessing data - Making pages dynamic.

UNIT – IV JOOMLA 9

Getting Started with Joomla - Essential Joomla - Installing Joomla - Mastering the Front Page - Joomla at Work - Building Navigation - Mastering Web Page Creation - Joomla Modules

UNIT – V JOOMLA IN REAL WORLD 9

Managing Web Site's Users - Driving Traffic to Web Site with Search Engine Optimization - Extending Joomla - Joomla Extensions

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand basics of Dreamweaver.
- Able to develop website in Dreamweaver.
- Understand and apply content management.
- Exposed to essentials of Joomla.
- Apply real world applications of Joomla.

TEXT BOOKS:

1. Adobe Dreamweaver Help and tutorials, Adobe, 2013
2. Steven Holzner, Nancy ConnerJoomla! For Dummies, Wiley Publishing, Inc, 2009

REFERENCES:

1. Using ADOBE® DREAMWEAVER® CS5 & CS5.5, Adobe, 2012
2. Adobe Dreamweaver CS3 User Guide, Adobe, 2007
3. Hagen Graf, Building Websites with Joomla! A step by step tutorial to getting your Joomla! CMS website up fast, Packt Publishing, 2006
4. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, Internet and World Wide Web how to program 5/e, Prentice Hall, 2011.
5. Robert Schifreen, The Web Book: How to create Web sites and applications with HTML, CSS, Javascript, PHP and MySQL , Oakworth publishing, 2009.
6. Jeffrey C and Jackson, Web Technologies A Computer Science Perspective , Pearson Education, 2011.

OCS1702 MOBILE APPLICATION DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- To appreciate the Mobility landscape
- To familiarize with Mobile apps development aspects
- To design and develop mobile apps, using Android as development platform, with key focus on user experience design, native data handling and background tasks and notifications.
- To appreciation of nuances such as native hardware play, location awareness, graphics, and multimedia.
- To perform testing, signing, packaging and distribution of mobile apps

UNIT I GETTING STARTED WITH MOBILITY 9

Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android platform, setting up the mobile app development environment along with an emulator, a case study on Mobile app development

UNIT II BUILDING BLOCKS OF MOBILE APPS 9

App user interface designing – mobile UI resources (Layout, UI elements, Draw-able, Menu), Activity-states and life cycle, interaction amongst activities.

UNIT III APP FUNCTIONALITY 9

App functionality beyond user interface - Threads, Async task, Services – states and life cycle, Notifications, Broadcast receivers, Telephony and SMS APIs - Native data handling – on-device file I/O, shared preferences, mobile databases such as SQLite, and enterprise data access (via Internet/Intranet)

UNIT IV SPRUCING UP MOBILE APPS 9

Graphics and animation – custom views, canvas, animation APIs, multimedia – audio/video playback and record, location awareness, and native hardware access (sensors such as accelerometer and gyroscope)

UNIT V TESTING MOBILE APPS AND TAKING TO MARKET 9

Debugging mobile apps, White box testing, Black box testing, and test automation of mobile apps, JUnit for Android, Robotium, MonkeyTalk - Versioning, signing and packaging mobile apps, distributing apps on mobile market place

TOTAL: 45 PERIODS

OUTCOMES:

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

- Appreciate the Mobility landscape.
- Familiarize with Mobile apps development aspects.
- Design and develop mobile apps, using Android as development platform, with key focus on user experience design, native data handling and background tasks and notifications.
- Appreciation of nuances such as native hardware play, location awareness, graphics, and multimedia.
- Perform testing, signing, packaging and distribution of mobile apps.

TEXT BOOK:

1. Anubhav Pradhan, Anil V Deshpande, Mobile Apps Development , First Edition, 2013

REFERENCES:

1. Barry Burd, Android Application Development All in one for Dummies, First Edition.
2. Teach Yourself Android Application Development In 24 Hours, SAMS, First Edition.

OCS1703 FUNDAMENTALS OF DATABASE L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- Expose of basics of Database.
- Familiarize with database design and ER diagrams.
- Expose to SQL Query Processing.
- Understand the fundamentals of Transaction Processing.
- Familiarize with the different storage media of databases.

UNIT I INTRODUCTION 9

Database-System Applications and purpose - View of Data - Database Languages - Relational Databases - Data Storage and Querying - Transaction Management - Database Architecture - Specialty Databases - Database Users and Administrators - History of Database Systems

UNIT II DATABASE DESIGN 9

Overview of the Design Process - The Entity-Relationship Model – Constraints - Removing Redundant Attributes in Entity Sets - Entity-Relationship Diagrams & design issues – Reduction to Relational Schemas - Other Aspects of Database Design

UNIT III INTRODUCTION TO SQL 9

Overview of the SQL Query Language - SQL Data Definition - Basic Structure of SQL Queries - Additional Basic Operations - Set Operations - Aggregate Functions - Nested Subqueries

UNIT IV TRANSACTION AND CONCURRENCY CONTROL 9

Transaction Concept - A Simple Transaction Mode - Serializability - Concurrency Control – Lock-Based Protocols - Deadlock Handling.

UNIT V STORAGE MEDIA IN DATABASE 9

Overview of Physical Storage Media – Magnetic Disks and Flash Storage – RAID – Tertiary storage – File Organization – Organization of Records in Files – Data-Dictionary Storage - Database Buffer

TOTAL: 45 PERIODS

OUTCOMES:

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

- Expose of basics of Database.
- Familiarized with ER diagrams.
- Understand to SQL Query Processing.
- Know the Transaction Processing.
- Familiarized with the different storage media of databases.

TEXT BOOK:

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, Database System Concepts, Sixth Edition, Tata Mc Graw Hill, 2011

REFERENCES:

1. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, Fifth Edition, Pearson Education, 2008.
2. C.J.Date, A.Kannan and S.Swamynathan, An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.
3. Raghu Ramakrishnan, Database Management Systems, Fourth Edition, Tata Mc Graw Hill, 2010.
4. G.K.Gupta, Database Management Systems, Tata Mc Graw Hill, 2011.
5. Rob Cornell, Database Systems Design and Implementation, Cengage Learning, 2011.

OSC1704 WEB PROGRAMMING WITH XML L T P C

3 0 0 3

OBJECTIVES:

The students should be made to:

- Learn web Programming basics.
- Understand different Internet Technologies.
- Learn HTML and CSS.
- Be exposed to essentials of XML usage in web programming.
- Understand xml specific Web Services Architecture.

UNIT I WEBSITES BASICS 8

Website Basics - Rich Internet Applications – Collaborations tools – websites vs web servers: Understanding Internet – websites vs web server- Internet technologies Overview –internet vs intranet

UNIT II HTML 5, CSS 3 10

HTML 5: Introduction to HTML5 – Headings – Linking – Images – Lists – Tables – Forms – Linking - New HTML5 Form input Types - input and data list Elements - Page-Structure Elements. **CSS 3:** Inline Styles - Embedded Style Sheets - External Style Sheets - Positioning Elements - Box Model and Text Flow - Text Shadows - Box Shadows - Animation; Selectors.

UNIT III DTML, JAVA SCRIPT 9

An introduction to JavaScript – Control Statements – Functions – Arrays - Date and Objects - DOM Model - Regular Expressions- Exception Handling-Validation-Built-in objects-Event Handling-DHTML with JavaScript.

UNIT IV XML 9

Essentials of XML - The Fundamentals of XML - Validating XML with DTD - XML Schemas - X-Files: XPath, XPointer, and XLink - Parsing XML Using Document Object Model - Parsing XML Using SAX - Transforming XML with XSL

UNIT V DATABASE AND WEB SERVICES 9

Integrating XML with Databases - Formatting XML for the Web - Architecting Web Services - Web Services Building Blocks: SOAP - Web Services Building Blocks: WSDL and UDDI

TOTAL: 45 PERIODS

OUTCOMES:

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

- Know web Programming basics.
- Understand different Internet Technologies.
- Develop web page using HTML and CSS
- Exposed to essentials of XML usage in web programming
- Understand xml specific Web Services Architecture.

TEXT BOOKS:

1. Deitel and Deitel and Nieto, Internet and World Wide Web – How to Program, Prentice Hall, Fifth Edition, 2011.
2. Ron Schmelzer et al. XML and Web Services – unleashed , Sams Publishing, 2002

REFERENCES:

1. Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, Pearson Education, 2011.
2. Gopalan N.P. and Akilandeswari J., Web Technology, Prentice Hall of India, 2011.
3. Uttam K.Roy, Web Technologies, Oxford University Press, 2011.
4. Chris Bates, Web Programming – Building Intranet Applications, Third Edition, Wiley Publications, 2009.

OSC1705 IoT AND ITS APPLICATIONS L T P C

3 0 0 3

OBJECTIVES:

The students should be made to:

- To understand what Internet of Things is.
- To identify the various elements of an IoT System
- To understand the various means of communication from Node / Gateway to Cloud Platforms
- To understand Cloud Computing & its relevance in IoT
- To identify types of data analytics and data visualization tools
- To make students aware of security concerns and challenges while implementing IoT solutions

UNIT I INTRODUCTION TO IoT 7

Definition of IoT - Evolution of IoT - IoT and related terms - Business Scope

UNIT II ELEMENTS OF IoT 8

Introduction to Elements of IoT - Basic Architecture of an IoT Application Sensors & Actuators - Edge Networking (WSN) – Gateways - IoT Communication Model – WPAN & LPWA

UNIT III COMMUNICATION AND CONNECTIVITY TECHNOLOGIES 9

Cloud Computing in IoT - IoT Communication Model – Cloud Connectivity

UNIT IV DATA ANALYTICS AND IoT PLATFORMS 9

Big Data Analytics - Data Visualization - IoT Platforms - Different Players of IoT - Security Concerns and Challenges

UNIT V CONCERNS AND FUTURE TRENDS 12

Future Trends – Standards - Hands-On Projects

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain what Internet of Things is.
- Describe components of IoT Architecture and platforms of IoT ecosystem.
- Describe and choose Sensors and Actuators.
- Describe and implement edge network.
- Describe Big Data Analytics, transform data and draw meaningful conclusions.
- Identify the DIY (Do it yourself) open source electronics platforms for building IoT prototypes.

TEXT BOOKS:

1. Oliver Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Applications and Protocols, Wiley publications.
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles, Architecting the Internet of Things, Springer publications.
3. Marco Schwatrz, Internet of Things with Arduino Cookbook, Packt Publications.

REFERENCE:

1. Internet of Things and Data Analytics, Wiley Publications.

OCS1706 PROGRAMMING IN C L T P C
2 0 2 3

OBJECTIVES:

The students should be made to:

- Be exposed to the syntax of C.
- Be familiar with conditional statements.
- Learn to use arrays and strings.
- Understand the features of functions and pointers.
- Understanding the purpose of structure, union and storage classes.

UNIT I C PROGRAMMING BASICS 6+3

Introduction to ‘C’ - Structure of a ‘C’ program – Character Set – Keywords - Identifiers – Constants – Variables – Basic Data Types – Operators and Expressions - Input and Output Functions.

UNIT II CONTROL STRUCTURES 6+3

Branching – Simple if – if else – nested if else – else if ladder – switch statement - Looping Statements – while - do while - for - goto - break – continue.

UNIT III ARRAYS AND STRINGS 6+3

Arrays – Initialization – Declaration – One dimensional arrays - Two dimensional arrays – Strings- String operations: length, compare, concatenate, copy, reverse – Bubble Sort – Linear Search.

UNIT IV FUNCTIONS AND POINTERS 6+3

Function Prototypes - Types of Function – Built-in functions (string functions, math functions) - Call by Value and Reference – Recursion – Pointers – Features of Pointers – Arithmetic Operations with pointers – Pointers and Arrays.

UNIT V STRUCTURES AND STORAGE CLASS 6+3

Structures – Definition – Declaration – Initialization – Operation on Structures – Array of Structures – Storage Class – Pre-processor Directives.

TOTAL: 30+15 PERIODS

OUTCOMES:

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

- Understand the basic programming constructs.
- Apply decision making and looping statements in developing C applications.
- Develop C programs by applying different operations of arrays and strings.
- Able to develop applications in C using functions and pointers.
- Apply the concept of structures and storage classes in developing various applications.

TEXT BOOKS:

1. Ashok.N.Kamthane, "Computer Programming", Second Edition, 2012, Pearson Education.

REFERENCES:

1. Anita Goel and Ajay Mittal, Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Yashavant P. Kanetkar. Let Us C, BPB Publications, 2011.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.
4. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
5. Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.

OCS1707 PROGRAMMING IN C++ L T P C
2 0 2 3

OBJECTIVES:

The students should be made to:

- To understand the basic C++ programming features
- To learn the characteristics of Object Oriented Programming
- To become familiar in Object Oriented Programming concepts
- To understand the reusability and polymorphism concepts
- To enhance the advanced features of C++.

UNIT I INTRODUCTION TO C++ 6+3

Introduction – Keywords – Identifiers and Constants – Basic Data Types – Reference Variables – C++ Programming Features – Control Structures – Functions – Function Prototypes – Parameter Passing methods – Default arguments.

UNIT II OBJECT ORIENTED PROGRAMMING FUNDAMENTALS 6+3

Object-Oriented Paradigm - Objects – Classes - Encapsulation and Data Abstraction – Inheritance – Polymorphism – Class Specification – Defining Member Functions – Static Data and Member Functions.

UNIT III OBJECT ORIENTED PROGRAMMING CONCEPTS 6+3

Constructors - Parameterized Constructors – Destructors – Constructor Overloading - Constructors with Default Arguments – Copy constructor – Friend Functions – Function Overloading.

UNIT IV POLYMORPHISM AND INHERITANCE 6+3

Operator Overloading – Unary Operator Overloading - Binary Operator Overloading – Inheritance - Forms of Inheritance – Virtual Functions.

UNIT V ADVANCED C++ FEATURES 6+3

Abstract Classes – Exception Handling– Generic Programming – Function Template – Class Template.

TOTAL: 30+15 PERIODS

OUTCOMES:

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

- Use the characteristics of an object-oriented programming.
- Use the basic object-oriented design principles in computer problem solving.
- Use the basic principles of constructor and friend functions.
- Apply the concepts of Inheritance and Operator overloading.
- Program with advanced features of the C++ programming language.

TEXT BOOKS:

1. K.R.Venugopal, B.Rajkumar and T.Ravishankar "Mastering C++" 2nd Edition, Tata McGraw Hill 2013.

REFERENCES:

1. Bjanne Stroustrup,"The C++ Programming Language",3rd Edition, Addison Wesley, 2000
2. Robert Lafore"Object Oriented Programming in C++" 4thEdition SAMS Publishing 2002
3. Herbert Schildt,"C++ The Complete Reference", Tata Mc Graw Hill Edition, 2003
4. Balagurusamy. E., "Object Oriented Programing wih C++", Tata McGraw Hill,1997.
5. Stanley, B.Lippman,JoveLagrie,"C++Primer",3rd Edition, Addison Wesley,1998
6. BhushanTrivedi "Programmingwith ANSI C++" 2ndEdition Oxford University Press 2013

OCS1708 JAVA PROGRAMMING LT P C
2 0 2 3

OBJECTIVES:

The students should be made to:

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 6+3

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance- Polymorphism- OOP in Java – Characteristics of Java–Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays.

UNIT II INHERITANCE AND INTERFACES 6+3

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the

Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface- Object cloning -inner classes, Array Lists – Strings.

UNIT III EXCEPTION HANDLING AND I/O 6+3

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions-Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console.

UNIT IV MULTITHREADING AND GENERIC PROGRAMMING 6+3

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads. Generic Programming – Generic classes – generic methods – Bounded Types.

UNIT V EVENT DRIVEN PROGRAMMING 6+3

Event handlers - adapter classes - actions - mouse events -AWT event hierarchy - Introduction to Swing – layout management - Swing Components.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop Java programs using OOP principles
- Develop Java programs with the concepts inheritance and interfaces
- Build Java applications using exceptions and I/O streams
- Develop Java applications with threads and generics classes
- Develop interactive Java programs using swings

TEXT BOOKS:

1. Herbert Schildt, ―Java The complete reference‖, 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, ―Core Java Volume –I Fundamentals‖, 9th Edition, Prentice Hall, 2013.

REFERENCES:

1. Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers‖, 3rd Edition, Pearson, 2015.
2. Steven Holzner, ―Java 2 Black book‖, Dreamtech press, 2011.
3. Timothy Budd, ―Understanding Object-oriented programming with Java, Updated Edition,Pearson Education, 2000.

OCS1709 COMPUTER PROGRAMMING L T P C
2 0 2 3

OBJECTIVES:

The students should be made to:

- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures in C.
- Be familiar in Object Oriented Programming Concepts of C++.
- Understanding the purpose of Polymorphism and Inheritance.

UNIT I C PROGRAMMING BASICS 6+3

Introduction to 'C' Programming - Structure of a 'C' program – Identifiers and keywords – Data Types – Variables and Constants – Expressions - Operators – Managing Input and Output Functions – Decision Making and Looping Statements.

UNIT II ARRAYS AND STRINGS 6+3

Arrays – Initialization – Declaration – Single dimensional arrays - Two dimensional arrays - Strings- String Library Functions - Sorting- Searching.

UNIT III FUNCTIONS, POINTERS & STRUCTURES 6+3

Function – User defined functions – Library Functions – Function Prototypes – Pass by value – Pass by reference Recursion – Pointers - Pointers arithmetic – Structures – Defining a Structure – Declaring Structure Objects – Operation on Structures – Array of structures.

UNIT IV C++ PROGRAMMING BASICS 6+3

Object Oriented Programming features – Class - Object - Encapsulation and Data Abstraction - constructors – Types of Constructors - Destructor – Friend functions- Static Data and Member functions – Function overloading.

UNIT V ADVANCED C++ FEATURES 6+3

Operator overloading: Binary operator overloading – Generic Programming - Function Template – Class Template - Inheritance – Virtual functions.

TOTAL: 35+15 = 45 periods

OUTCOMES:

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

- Understand the fundamentals and choose the loops and decision making to solve the problems.
- Implement different operations on arrays and strings.
- Able to implement functions, pointers and structures.
- Understand and apply object oriented features and C++ concepts.
- Apply the concept of polymorphism and inheritance.

TEXT BOOKS:

1. Anita Goel and Ajay Mittal, Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. K.R Venugopal, RajkumarBuyya, T Ravishankar, Mastering C++, Tata McGraw-Hill Publishing Company Limited, 2006.

REFERENCES:

1. Ashok.N.Kamthane,Computer Programming, Pearson Education (India) (2008).
2. Yashavant P. Kanetkar. Let Us C, BPB Publications, 2011.
3. Balagurusamy. E., Object Oriented Programing with C++, Seventh edition, Tata McGraw Hill, 1997.
4. Robert Lafore, Object Oriented Programming in C++, Fourth Edition SAMS Publishing 2002
5. Bjarne Stroustrup, The C++ Programming Language, Third Edition, Pearson Education, 2007.

OPEN ELECTIVE OFFERED BY DEPT OF ELECTRICAL AND ELECTRONICS ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OEE 1701	Renewable Power Generation Systems	OE	3	3	0	0	3
2.	OEE1702	Electrical Safety and Quality Assurance	OE	3	3	0	0	3
3.	OEE1703	Sensors and Transducers	OE	3	3	0	0	3
4.	OEE1704	Electric Power Utilization	OE	3	3	0	0	3
5.	OEE1705	Electrical Machines	OE	3	3	0	0	3

OEE1701 RENEWABLE POWER GENERATION SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To impart the knowledge on various forms of renewable energy sources and the process of electric energy conversion

UNIT I ELECTRIC POWER GENERATION FROM CONVENTIONAL SOURCES 9

Environmental aspects of electric power generation from conventional sources: Limitation of fossil fuels - Atmospheric pollution – effects of hydro-electric projects – disposal of nuclear waste – GHG emission from various energy sources and its effects – need for renewable energy sources.

UNIT II SOLAR PHOTO-VOLTAIC SYSTEM 9

Solar radiation and its measurement – Angle of sun rays on solar collector– optimal angle for fixed collector – sun tracking, an introduction to solar cell, solar PV module, PV system design and applications – stand-alone and grid connected systems, environmental impacts.

UNIT III WIND POWER GENERATION 9

Wind energy, classification of wind turbines – aerodynamic operation of wind turbine, extraction of wind turbine power, wind turbine power curve, horizontal axis wind turbine generator – modes of wind power generation – stand-alone and grid connected system, environmental impacts.

UNIT IV FUEL CELL SYSTEM 9

Principle of operation of fuel cell, technical parameters of fuel cell, Type of fuel cell – advantages of fuel cell power plants, energy output, efficiency and emf of fuel cell – operating characteristics, applications and environmental impacts.

UNIT V HYBRID ENERGY SYSTEMS 9

Need for hybrid systems, types, configuration and coordination, electrical interface – PV-Diesel, Wind-diesel, wind-PV, wind-PV- fuel cell.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to:

- Explain the process of PV generation and design stand-alone and grid connected system.
- Explain the process of wind power generation and choose stand-alone and grid connected configuration.

TEXT BOOKS:

1. G D Rai, 'Non-conventional Energy sources', Khanna Publishers, 5th Edition, 2014.
2. D P Kothari, K C Singal and Rakesh Ranjan, 'Renewable Energy Sources and Emerging Technologies' 2nd Edition, 2012.

REFERENCES:

1. C S Solanki, 'Solar Photo-voltaics – Fundamentals, Technologies and Applications', PHI Pvt., Ltd., 2nd Edition, 2011.
2. S N Bhadra, D Kastha and S Banerjee, 'Wind Electric Systems', Oxford Publications, 2nd Edition, 2007.

OEE1702 ELECTRICAL SAFETY AND QUALITY ASSURANCE L T P C
3 0 0 3

OBJECTIVES:

- To provide a comprehensive exposure to electrical hazards, various grounding techniques, safety procedures and various electrical maintenance techniques.

UNIT I HAZARDS AND SAFETY KIT 9

Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line diagram- electrician's safety kit.

UNIT II GROUNDING AND BONDING 9

General requirements for grounding and bonding- definitions- grounding of electrical equipment bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment- system grounding- purpose of system grounding- grounding electrode system grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment-grounding of low voltage and high voltage systems.

UNIT III SAFETY METHODS 9

The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system-lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment , procedure for low, medium and high voltage systems- the one minute safety audit

UNIT IV ELECTRICAL SAFETY PROGRAMME 9

Electrical safety programme structure, development- company safety team- safety policy programme implementation- employee electrical safety teams- safety meetings- safety audit accident prevention-first aid- rescue techniques-accident investigation

UNIT V ELECTRICAL SAFETY STANDARDS 9

Safety related case for electrical maintenance- Reliability Centered Maintenance (RCM) - Eight step maintenance programme- frequency of maintenance- maintenance requirement for specific equipment and location- regulatory bodies- national electrical safety code- standard for electrical safety in work place- occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to:

- Describe electrical hazards and safety equipment.
- Analyze and apply various grounding and bonding techniques.
- Select appropriate safety method for low, medium and high voltage equipment.
- Participate in a safety team.
- Carry out proper maintenance of electrical equipment by understanding various standards.

TEXT BOOKS:

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield ,'Electrical Safety Handbook', McGraw-Hill Education, 4th Edition, 2012.

REFERENCES:

1. Maxwell Adams.J, 'Electrical Safety- a guide to the causes and prevention of electric hazards', The Institution of Electric Engineers, IET 1994.
2. Ray A. Jones, Jane G. Jones, 'Electrical Safety in the Workplace', Jones & Bartlett Learning, 2000.

OEE1703 SENSORS AND TRANSDUCERS L T P C
3 0 0 3

OBJECTIVES:

- To understand how physical quantities are measured and how they are converted to electrical or other forms.
- To have an adequate knowledge in resistance, transducers.
- To develop the knowledge of inductance and capacitance transducers.
- To study the characteristics of transducers.
- To impart knowledge on various types of transducers

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Units and standards – Calibration methods – Static calibration – Classification of errors:- Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty-Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: – Accuracy, precision, resolution, sensitivity, linearity, span and range – Dynamic characteristics: – Mathematical model of transducer – Zero, I and II order transducers - Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Induction potentiometer – Variable reluctance transducers – EI pick up – Principle of operation, construction details, characteristics and applications of LVDT –Capacitive transducer and types – Capacitor microphone – Frequency response.

UNIT V OTHER TRANSDUCERS 9

Piezoelectric transducer - Hall Effect transducer – Magneto elastic sensor- Digital transducers –Smart sensors - Fibre optic sensors- Film sensors-Introduction to MEMS and Nano sensors.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to ability to model and analyze transducers.

TEXT BOOKS:

1. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003.
2. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.
3. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.

REFERENCES:

1. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2000.
2. Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., NewDelhi, 2010.
3. W.Bolton, Engineering Science, Elsevier Newnes, Fifth edition, 2006.
4. Ramón Pallás-Areny, John G. Webster, Sensors and Signal Conditioning, Wiley-Interscience 2nd Edition, 1991.
5. Bela G.Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
6. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012.

OEE1704 ELECTRIC POWER UTILIZATION L T P C
3 0 0 3

OBJECTIVES:

- To understand the principles of operation and utilization of power in domestic and industrial appliances.

UNIT I ILLUMINATION 9

Illumination – Terminology, Laws of illumination, lighting calculations. Electric lamps – Different types of lamps, LED lighting and Energy efficient lamps, Design of lighting schemes - factory lighting – flood lighting – street lighting.

UNIT II REFRIGERATION 9

Refrigeration - Domestic refrigerator and Air coolers, Air-Conditioner – circuit diagram, types and principle of operation.

UNIT III DOMESTIC UTILIZATION OF ELECTRICAL ENERGY 9

Domestic utilization of electrical energy – House wiring, Induction based appliances, Online and OFF line UPS, Earthing – domestic, industrial and sub-station.

UNIT IV ELECTRIC HEATING 9

Electric Heating - Types of heating and applications, Electric furnaces - Resistance, inductance and Arc Furnaces, Electric welding and sources of welding.

UNIT V ELECTRIC DRIVES AND TRACTION SYSTEM 9

Electric Drives and Traction System – Type of drives and loads, Rating and heating of the motors, Types of Traction, Speed-Time curves, recent trends in traction.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to:

- Develop a clear idea on various illumination techniques and hence design lightening scheme for specific applications.

- Construct an electric connection for any domestic appliance like refrigerator and air conditioner units.
- Evaluate domestic wiring connection and debug any faults occurred.
- Identify an appropriate method of heating and welding for any particular industrial application.
- Realize the appropriate type of electrical supply system as to evaluate the performance of tractions and electrical drives.

TEXT BOOKS:

1. Dr. Uppal S.L. and Prof. S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 2009.
2. Rajput R.K.,'Utilisation of Electrical Power', Laxmi Publications, 1st Edition, 2007.
3. N.V Suryanarayana, 'Utilization of Electric Power' New Age International Publishers, Reprinted 2005.

REFERENCES:

1. C.L.Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', New Age International Publishers, 4th Edition, 2011.
2. Gupta, J.B., 'Utilisation of Electrical Energy and Electric Traction', S.K.Kataria and Sons, 10th Edition,1990.

OEE1705 ELECTRICAL MACHINES L T P C
3 0 0 3

OBJECTIVES:

- To disseminate an overview of various electric machines used in industries, power generation and home appliances with a technical know-how on the control techniques.

UNIT I DC MOTORS 9

Construction and working principle, emf equation, torque equation, starting and running characteristics, speed control, braking, duty of operation, choice of motors.

UNIT II TRANSFORMERS 9

Construction and working principle, equivalent circuit, regulation and efficiency, autotransformers, industrial applications – welding transformer and furnace transformer.

UNIT III THREE PHASE INDUCTION MACHINES 9

Construction and working principle. Induction motors – torque equation, torque–slip characteristics, starting and running characteristics, speed control, braking, choice of motor for industrial applications and traction.

UNIT IV SYNCHRONOUS MACHINES 9

Construction, principle of operation and types, various types of excitation systems, stand alone and grid connected modes of operation, voltage and frequency control.

UNIT V FRACTIONAL HORSE POWER MACHINES 9

Single phase induction motors – Construction and principle of operation, types, applications in home appliances. Construction, operation and applications of Brushless DC motors, Stepper motors, Servomotors and AC Series motors

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the constructional details and principle of operation of DC motors, induction machines, alternators, transformers and fractional horse-power motors.
- Evaluate the performance of starting and operating characteristics of various electrical machines used in industrial and domestic applications.
- Choose an appropriate method of speed control and braking for the drive motors

TEXT BOOKS:

1. D.P.Kothari and I.J.Nagrath, 'Electric Machines', McGraw Hill Education Private Limited, 4th Edition, 2010.
2. Gopal K. Dubey, 'Fundamentals of Electrical Drives', Narosa publishing house, 2nd Edition, 2011.
3. A Fitzgerald , Charles Kingsley , Stephen Umans, 'Electric Machinery', McGraw Hill Education Private Limited, 6th Edition, 2002.

REFERENCES:

1. K. Murugesh Kumar, 'Induction & Synchronous Machines', Vikas Publishing House Pvt Ltd., 2009.
2. Edward Hughes, 'Electrical and Electronic Technology', Dorling Kindersley (India) Pvt. Ltd., 10th Edition, 2011.

OPEN ELECTIVE OFFERED BY DEPT OF ELECTRONICS AND COMMUNICATION

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OEC1701	MEMS and its applications	OE	3	3	0	0	3
2.	OEC1702	Consumer Electronics	OE	3	3	0	0	3
3.	OEC1703	Digital Image Processing and its applications	OE	3	3	0	0	3
4.	OEC1704	Pattern Recognition and Artificial Intelligence	OE	3	3	0	0	3
5.	OEC1705	Electronics Engineering	OE	3	3	0	0	3

OEC1701 **MEMS and its Applications** **L T P C**
3 0 0 3

OBJECTIVES:

This course is intended to introduce the students to

- MEMS and Micro fabrication
- Properties of MEMS materials
- Principles behind sensing and actuation using MEMS devices
- Micromachining techniques
- Polymers in MEMS and optical MEMS

UNIT I INTRODUCTION TO MICRO ELECTRO MECHANICAL SYSTEMS (MEMS) AND MICROFABRICATION 9

History of MEMS Development, Characteristics of MEMS-miniaturization - micro electronics integration - Mass fabrication with precision. Micro fabrication - microelectronics fabrication process-silicon based MEMS processes

UNIT II ELECTRICAL AND MECHANICAL PROPERTIES OF MEMS MATERIALS 9

Conductivity of semiconductors, crystal plane and orientation, stress and stain – definition – relationship between tensile stress and stain- mechanical properties of silicon and thin films, Flexural beam bending analysis under single loading condition- Types of beam- deflection of beam-longitudinal stain under pure bending spring constant, torsional deflection, intrinsic stress, resonance and quality factor.

UNIT III SENSING AND ACTUATION 9

Electrostatic sensing and actuation-parallel plate capacitor – Application-Inertial, pressure and tactile sensor parallel plate actuator- comb drive. Thermal sensing and Actuations-thermal sensors-Actuators-Applications- Inertial, Flow and Infrared sensors. Piezo resistive sensors- piezo resistive sensor material-stress in flexural cantilever and membrane application-inertial, pressure, flow and tactile sensors.

Piezoelectric sensing and actuation- piezoelectric material properties-quartz-PZT-PVDF–ZnO application-inertial, Acoustic, tactile, flow-surface elastic waves magnetic actuation- Micro magnetic actuation principle- deposition of magnetic materials-Design and fabrication of magnetic coil.

UNIT IV BULK AND SURFACE MICROMACHINING 9

Anisotropic wet etching, Dry etching of silicon, Deep reactive ion etching (DRIE), Isotropic wet etching, Basic surface micromachining process- structural and sacrificial material, stiction and anti stiction methods, Foundry process.

UNIT V APPLICATIONS OF MEMS 9

MEMS Sensors and their Applications-Acceleration, pressure, flow and tactile sensors, Optical MEMS-passive MEMS, optical components-lenses-mirrors-Actuation for active optical MEMS, Biotechnology and medicine- biochips for detection of hazardous chemical and biological agents, and microsystems for high-throughput drug screening and selection , MEMS pressure sensors for monitoring blood pressure, drug delivery and implantable devices.

TOTAL = 45 PERIODS

OUTCOMES:

Upon completion of the course students will

- Understand the advantages of MEMS
- Gain knowledge on properties of materials used MEMS technology
- Appreciate the principles behind MEMS sensors and actuators
- Get acquainted with micromachining processes
- Acquire knowledge in polymers used in MEMS and their applications

TEXT BOOKS:

1. Foundations of MEMS by Chang Liu (2nd edition), 2012

REFERENCES:

1. Tai-Ran Hsu , “MEMS and Microsystems” (2nd edition), 2008.

2. Stephen Senturia, “ Microsystem” , Springer, 2014.

3. GaberielM.Rebiz, “RF MEMS Theory,Design and Technology”, John Wiley & Sons,2003.

4. CharlesP.Poole, Frank J.Owens, “Introduction to nanotechnology” , John Wiley & sons, 2003.

5. Julian W.Gardner, Vijay K Varadhan, “Microsensors, MEMS and Smart devices”, John Wiley & sons, 2001.

OEC1702 CONSUMER ELECTRONICS L T P C

3 0 0 3

OBJECTIVES

- To provide comprehensive idea about the fundamentals of Electronic devices, Digital Electronics, Microprocessors and Microcontrollers.
- To understand the Electronics for entertainment activity
- To acquire the knowledge on technology involved in Smart home.
- To be Familiar about Home enablement systems
- To know the essentials of Communication Systems.

UNIT I CONSUMER ELECTRONICS FUNDAMENTALS 9

History of Electronic Devices- Transistors, Integrated Circuits- Moorse Law, Semiconductor Devices, Diodes, Rectifiers, Transistors, Logic Gates, Combinational Circuits, ADC, DAC and Microprocessors, Microcontrollers and Microcontrollers in consumer electronics, Energy management, Intelligent Building Perspective.

UNIT II ENTERTAINMENT ELECTRONICS 9

Audio systems: Construction and working principle of Microphone, Loud speaker, AM and FM receiver, stereo, 2.1 home theatre, 5.1 home theatre . Display systems: LCD, LED and Graphics displays. Video Players : DVD and Blue RAY. Recording Systems: Digital Cameras and Camcorders.

UNIT III SMART HOME 9

Technology involved in Smart home, Home Virtual Assistants- Alexa and Google Home. Home Security Systems - Intruder Detection, Automated blinds, Motion Sensors, Thermal Sensors and Image Sensors, PIR, IR and Water Level Sensors.

UNIT IV HOME APPLIANCES 9

Home Enablement Systems: RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Kitchen Electronics- Microwave, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart toilet, Smart floor, Smart locks.

UNIT V COMMUNICATION SYSTEMS 9

Cordless Telephones, Fax Machines, PDAs- Tablets, Smart Phones and Smart Watches. Introduction to Smart OS- Android and iOS. Video Conferencing Systems- Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, IoT, Li-Fi, GPS and Tracking Systems.

TOTAL=45 PERIODS

OUTCOMES:

Students will be able to

- Accomplish knowledge on Electronic devices, Digital Electronics, Microprocessors and Microcontrollers.
- Recognize the Electronics for entertainment activity
- Attain knowledge of smart Home
- Identify the smart home technology
- Familiar with communication systems.

TEXT BOOKS:

1. Thomas L Floyd, "Electronic Devices" 10th Edition Pearson Education Asia 2018.
2. Philp Hoff, "Consumer Electronics for Engineers" - Cambridge University Press.1998.
3. Jordan Frith, “Smart phones as Locative Media ", Wiley. 2014.
4. Dennis C Brewer, “Home Automation", Que Publishing 2013.
5. Thomas M. Coughlin, "Digital Storage in Consumer Electronics", Elsevier and Newness 2012.

OEC1703 DIGITAL IMAGE PROCESSING AND ITS APPLICATIONS L T P C

3 0 0 3

OBJECTIVES: The student should be made to:

- Learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Be familiar with restoration and segmentation techniques
- Understand lossy and loss less compression techniques
- Learn to represent image in form of features

UNIT I DIGITAL IMAGE FUNDAMENTALS 8

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sampling and Quantization

UNIT II IMAGE ENHANCEMENT AND RESTORATION 10

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering – Frequency Domain: Smoothing and Sharpening frequency domain filters –. Noise models – Mean Filters – Inverse Filtering – Wiener filtering

UNIT III IMAGE SEGMENTATION AND COMPRESSION 9

Segmentation: Detection of Discontinuities— Region based segmentation. Compression: Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding –Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding.

UNIT IV IMAGE REPRESENTATION 9

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors – Topological feature, Texture

UNIT V IMAGE RECOGNITION AND MORPHING 9

Patterns and Pattern classes - Recognition based on decision theoretic methods. Image morphing- Recent advances in image morphing. Detection of morphed face image- any case study.

TOTAL= 45 PERIODS

OUTCOMES:

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

- Discuss digital image fundamentals.
- Apply image enhancement and restoration techniques
- Use image compression and segmentation Techniques.
- Represent features of images
- Detect morphed image

TEXT BOOK:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
4. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.
5. http://eeweb.poly.edu/~onur/lectures/lectures.html.
6. http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html
7. http://andrew.gibiansky.com/blog/image-processing/image-morphing/

OEC1704 Pattern Recognition and Artificial Intelligence

L	T	P	C
3	0	0	3

OBJECTIVES:

To understand the fundamentals of Pattern recognition.

- To learn unsupervised classification
- To learn to choose an appropriate feature, pattern classification algorithm for a pattern recognition problem.
- To enrich the knowledge with fuzzy systems and its applications
- To enrich the knowledge with recent advances and applications using fuzzy systems.

UNIT I OVERVIEW OF PATTERN RECOGNITION 9

Discriminant functions- Supervised learning - Parametric estimation-Maximum Likelihood estimation - Bayesian parameter estimation – Problems with Bayes Approach. Non Parametric techniques, Perceptron Algorithm-LMSE Algorithm- Pattern classification by distance functions - minimum distance Pattern classifier.

UNIT II UNSUPERVISED CLASSIFICATION 9

Clustering for unsupervised learning and classification, clustering concepts hierarchical clustering,

Partitional clustering, k- means algorithm - Validity of clustering solutions.

UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9

KL Transforms - feature selection through functional approximation - Binary selection Elements of formal grammars, syntactic description, stochastic grammars, Structural representation.

UNIT IV FUZZY SYSTEMS 9

Fuzzy sets and fuzzy reasoning- fuzzy matrices-fuzzy functions-decomposition – Fuzzy inference systems Mamdani and Sugeno model, Fuzzy clustering- fuzzy c- means algorithmfuzzy control method-fuzzy decision making.

UNIT V RECENT ADVANCES AND APPLICATIONS 9

Principle of neuro fuzzy techniques, Application of PR in image segmentation – CAD system in Breast cancer detection, ECG signal analysis, Fingerprint identification - Cell cytology classification

TOTAL PERIODS =45

OUTCOMES:

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

- Develop an idea about the fundamentals of Pattern recognition.
- Demonstrate on unsupervised classification
- Describe feature extraction and structural pattern recognition.
- Acquire the knowledge of fuzzy systems & its applications.
- Carry out recent advancements in life science & technology using Fuzzy techniques

REFERENCES:

1. Duda R.O., and Hart P.G.,Pattern Classification and scene analysis, JohnWiley, New York, 1973.
2. Earl Gose, Richard Johnsonbaugh, Steve Jost, Pattern Recognition and Image analysis, Prentice Hall of India, New Delhi - 2007.
3. Robert J. Schalkoff , Pattern recognition: Statistical, Structural and Neural approaches,John Wiley and Sonslnc, New York, 1992.
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley and sons, New York, 1993.
5. Andrew Webb, Statistical Pattern Recognition, Arnold publishers, London,1999.
6. Donna L. Hudson, Maunee E. Cohan, Neural Networks & Artificial Intelligence for Biomedical Engineering, Prentice Hall of India, New Delhi - 2001.
7. Timothy Ross, Fuzzy Logic with Engineering applications,2nd Edition John Wiley and sons,West Sussex,2004.

OEC1705 ELECTRONICS ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To study the extension of semiconductor devices on power and display devices
- To study the construction, theory and operation of basic electronic devices such as PN junction diode, Zener, BJT, FET and MOSFET
- To educate basic postulates of Boolean algebra and illustrate the formal procedures for the analysis and design of combinational circuits and Sequential circuits
- To infer knowledge on integrated circuits and SMD
- To know about the different types of electronics system

UNITI ELECTRONIC COMPONENTS 9

History, Evolution and Inventors of Electronic Components - Resistors, Capacitors andInductors -Types, Construction and Functions, Cables - Construction, Characteristics, Types- High Impedance, Low Impedance, Ribbon, High Temperature, Flat Twin, RF, Telephone, Optical Fiber,Connectors, Switches, Relays, Displays - LED, Alphanumeric, LCD,LASER.

UNITII DEVICESANDAPPLICATIONS 9

History, Evolution and Inventors of ElectronicDevices- PN Junction Diodes, Zener, BipolarJunction Transistors, Field Effect Transistors, Unijunction Transistors, Silicon ControlledRectifier -Working andSimple Applications.

UNITIII DIGITALELECTRONICS 9

Boolean algebra, Logic Gates, Half and Full adders, Decoder, Encoder, Multiplexer, Demultiplexer, Flip flops, Digital to Analog converters, Analog to Digital converters, RealTime Multi-Charmel Data Acquisition System - Working and Demonstrations.

UNITIV INTEGRATED CIRCUITS AND SMD 9

Evolution and Inventors ofIntegrated Circuits - Structure, Scale/Level, Classification, Surface Mount Devices and Surface Mount Technology, Printed Circuit Boards, SemiconductorManufacturing.

UNITV ELECTRONIC SYSTEMS 9

Agriculture Robots - Detection (Navigation, Soil and Crop Sensors), Processing,and Actuation, Automotive electronics - Engine Control, Braking, Driver Assistance,Navigation, Safety and Communication Systems.

TOT AL: 45PERIODS

OUTCOMES:

Upon completion of the course, the students are able to

- Analyze the components associated with power control and opto-electronic devices
- Describe the essence of the diode functions and its characteristics
- Reproduce the basic postulates of Boolean algebra and apply the procedure to Design and Implement Combinational and Sequential circuits
- Familiar with the integrated circuits and SMD
- Analyze the various control, safety and communication systems

TEXT BOOK:

1.Malvino, 'Electronic Principles', McGraw BookCo., 1993.

REFERENCES:

1. Grob. B and Schultz.M.E. 'Basic Electronics', Tata McgrawHill, 2003.
2. Thomas L.Floyd, 'Electronics Devices', Pearson Education, 2002.
3. Thomas L.Floyd, 'Digital Fundamentals', Pearson Education, 2003.
4. Millman, HalkiasJacob, Jit Christosand Satyabrata,'Electronic devices and Circuits', Tata McGrawHill, 2nd Edition,
5. V. R. Deo, Electronic Components and Applications, Ane Books Pvt. Ltd.,
6. https:\\www.semiconductors.org/majn/resources, technav.ieee.orgltagJ5783/electronic-noses, www.tsunarni.noaa.gov, www.e-booksdirectory.com,
7. Make Electronics - Learning by Discovery by Charles Platt

OPEN ELECTIVES OFFERED BY DEPT OF INFORMATION TECHNOLOGY

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OIT1701	Data Science	OE	3	3	0	0	3
2.	OIT1702	Advanced Python Programming	OE	3	3	0	0	3
3.	OIT1703	Business Intelligence	OE	3	3	0	0	3
4.	OIT1704	Computer Vision	OE	3	3	0	0	3
5.	OIT1705	Cyber Security	OE	3	3	0	0	3
6.	OIT1706	Machine Learning and R Programming	OE	3	3	0	0	3

OIT1701 DATA SCIENCE LT P C
3 0 0 3

OBJECTIVES:

The student should be able to

- Able to apply fundamental algorithmic ideas to process data.
- Learn to apply hypotheses and data into actionable predictions.
- Document and transfer the results and effectively communicate the findings using visualization techniques.

UNIT I INTRODUCTION TO DATA SCIENCE 9

Data science process – roles, stages in data science project – working with data from files – working with relational databases–exploring data–managing data–cleaning and sampling for modeling and validation – introduction to NoSQL. (Ref. Book 1: Chapter 1-4)

UNIT II MODELING METHODS 9

Choosing and evaluating models – mapping problems to machine learning, evaluating models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logisticregression – unsupervised methods. (Ref. Book 1: Chapter 5-8)

UNIT III INTRODUCTION TO R 9

Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R - manipulating objects – data distribution. (Ref. Book 3: Chapter 2,5 & Ref. Book 4: Chapter 5-8,11)

UNIT IV MAP REDUCE 9

Introduction–distributed file system–algorithms using mapreduce, Matrix-Vector Multiplication by Map Reduce–Hadoop-Understanding the Map Reduce architecture- Writing Hadoop Map Reduce Programs-Loading data into HDFS – Executing the Map phase-Shuffling and sorting - Reducing phase execution. (Ref. Book 2: Chapter 2 & Ref. Book 8: Chapter 1-8)

UNITV DELIVERING RESULTS 9

Documentation and deployment –producing effective presentations – Introduction to graphical analysis–plot() function–displaying multivariate data–matrix plots –multiple plots in one window - exporting graph - using graphics parameters. Case studies (Ref. Book 1: Chapter 10-11 & Ref. Book 9: Chapter 12)

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able

1. To know principles of data science
2. To apply fundamental algorithmic ideas to process data.
3. To apply hypotheses and data into actionable predictions.
4. To implement applications using Hadoop.
5. To Document and transfer the results and effectively communicate the findings using visualization techniques

REFERENCES

1. Nina Zumel, John Mount, "Practical DataScience with R", Manning Publications, 2014.
2. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014.
3. 3. Mark Gardener, "Beginning R - The Statistical Pr ogramming Language", John Wiley Sons, Inc., 2012.
4. W. N. Venables, D. M. Smith and theR Core Team, "An Introduction to R", 2013.
5. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd., 2014.
6. Nathan Yau, "Visualize This: The FlowingDataGuide to Design, Visualization, and
    a. Statistics", Wiley, 2011.
7. Boris lublinsky, Kevin t. Smith, AlexeyYakubovich, "Professional Hadoop Solutions",
8. Wiley, ISBN: 9788126551071, 2015.
9. Tom White, "Hadoop: The Definitive Guide", Oreilly - Storage and Analysis at Internet Scale, Third Edition, 2012
10. http://www.johndcook.com/R_language_for_programmers.html
11. http://bigdatauniversity.com/
12. http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction

OIT1702 ADVANCED PYTHON PROGRAMMING L T P C

3 0 0 3

OBJECTIVES:

- To know the basics of python
- To execute SQL queries.
- To connect Python with database.
- To understand the concepts of object oriented programming.
- To demonstrate concurrent execution using multiple threads.

UNIT I PROGRAMMING FUNDAMENTALS 9

Python's core data types - Operators – Strings - Conditional Statements – Looping Statements - Lists - Methods – dictionaries - Methods – Tuples - Set – Files [Ref 2 - Chapter 6 - 10]

UNIT II DATABASE FUNDAMENTALS 9

Keys in RDBMS - Normalization – 1NF – 2NF – 3NF – BCNF - DDL – DML – DCL – TCL – Sorting data - Single row functions – Joins – Group functions – Sub queries [Ref 3 – Chapter 3 and 4]

UNIT III OBJECT ORIENTED PROGRAMMING USING PYTHON 9

Decorators – Class and Object namespaces – Attribute shadowing – Initializing an instance – Inheritance and composition – Accessing a base class – Multiple Inheritance – Class and static methods – Private methods and name mangling – The property decorator - Operator overloading – Polymorphism – Data Classes – Writing an iterator [Ref-1 Chapter 6]

UNIT IV PYTHON DATABASE INTEGRATION 9

Connection and Cursor Objects - Retrieve Data from Database – Insert Operation – Update Operation – Delete Operation – Select Operation

UNIT V CONCURRENT EXECUTION 9

Threads and Processes – Killing threads – context switching - Global interpreter lock – Race conditions and deadlocks – Locks to the rescue – starting a thread –Starting a process – Stopping threads and processes – Spawning multiple threads – Dealing with race conditions – Thread and process communication – case examples – concurrent merge sort – two batch Sudoku solver [Ref-1 Chapter 10]

TOTAL: 45 PERIODS

REFERENCES:

1. Learn Python Programming: A beginner's guide to learning the fundamentals of Python language to write efficient, high-quality code, by Fabrizio Romano, 2nd Edition.
2. Mark Lutz, Learning Python: Powerful Object-Oriented Programming, Fifth Edition, O'Reilly, Shroff Publishers and Distributors, 2013.
3. Database System Concepts by Abraham Silberschatz, Henry F. Korth , S. Sudarshan , 5th edition

OUTCOMES

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

1. Know the basics of python and implement it.
2. Execute SQL queries.
3. Connect Python with database.
4. Understand the concepts of object oriented programming.
5. Demonstrate concurrent execution using multiple threads.

OIT1703 **BUSINESS INTELLIGENCE** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to

- Be exposed with the basic rudiments of business intelligence system
- understand the modeling aspects behind Business Intelligence
- understand of the business intelligence life cycle and the techniques used in it
- Be exposed with different data analysis tools and techniques

UNIT I BUSINESS INTELLIGENCE **9**

Effective and timely decisions – Data, information and knowledge – Role of mathematical models – Business intelligence architectures: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – Development of a business intelligence system – Ethics and business intelligence. (Ref. Book 1: Chapter 1)

UNIT II MATHEMATICAL MODELS AND METHODS **9**

Mathematical models for decision making-Data mining-Data preparation-Data exploration-Regression-Time series-Classification-Association rules-Clustering (Ref. Book 1: Chapter 4-12)

UNIT III EFFICIENCY **9**

Efficiency measures – The CCR model: Definition of target objectives- Peer groups – Identification of good operating practices; cross efficiency analysis – virtual inputs and outputs – Other models. Pattern matching – cluster analysis, outlier analysis (Ref. Book 1: Chapter 15)

UNIT IV BUSINESS INTELLIGENCE APPLICATIONS **9**

Marketing models – Logistic and Production models – Case studies. (Ref. Book 1: Chapter 13 and 14)

UNIT V FUTURE OF BUSINESS INTELLIGENCE **9**

Future of business intelligence – Emerging Technologies, Machine Learning, Predicting the Future, BI Search & Text Analytics – Advanced Visualization – Rich Report, Future beyond Technology
(Ref. Book 1: Chapter 14)

TOTAL: 45 PERIODS

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

1. Explain the fundamentals of business intelligence.
2. Link data mining with business intelligence.
3. Apply various modeling techniques.
4. Explain the data analysis and knowledge delivery stages.
5. Apply business intelligence methods to various situations.
6. Decide on appropriate technique.

REFERENCES
1.Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications, 2009.
2.Cindi Howson, "Successful Business Intelligence: Secrets to Making BI a Killer App", McGraw-Hill, 2007.
3. Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9th Edition, Pearson 2013.
4. Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley, 2003.
5.David Loshin Morgan, Kaufman, "Business Intelligence: The Savvy Manager"s Guide", Second Edition, 2012.
6.Ralph Kimball , Margy Ross , Warren Thornthwaite, Joy Mundy, Bob Becker, "The Data Warehouse Lifecycle Toolkit", Wiley Publication Inc.,2007.

OIT1704 COMPUTER VISION L T P C
3 0 0 3

OBJECTIVES:

- To review image processing techniques for computer vision
- To understand vision fundamentals and image processing fundamentals
- To understand shape and region analysis
- To understand Hough Transform and its applications to detect lines, circles, ellipses
- To understand motion analysis
- To study some applications of computer vision algorithms

UNIT I FUNDAMENTALS OF VISION AND IMAGE PROCESSING 9
Image Formation and Representation, Intensity and Range Images – Thresholding techniques – edge detection techniques – corner and interest point detection – Light and colour – Image Noise – Image Filtering (spatial domain) - Mask-based filtering - Image Smoothing and Sharpening.
(Ref. Book 2: Chapter 2 & Ref. Book 4 Chapter 1-2)

UNIT II IMAGE FEATURES 9
Image Features – Point and Line Detection – Hough Transform – Edge Detection – Corner Detection – Harris Detector – Textures - Deformable Contours – Features Reduction –Principal Component analysis – Feature Descriptors – SIFT and SURF. (Ref. Book 3: Chapter 2-4 & Ref. Book 4 Chapter 1-2)

UNIT III SHAPES AND REGIONS 9
Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments (Ref. Book 4: Chapter 2)

UNIT IV CAMERA CALIBRATION AND STEREO GEOMETRY 9
Camera models – Camera parameters– Intrinsic and Extrinsic parameters – Direct Parameter Calibration –Extraction from Projection matrix, Stereopsis – Correspondence Problem –RANSAC and Alignment - Epipolar Geometry (Ref. Book 4: Chapter 1 & Ref. Book 1 Chapter 1-2)

UNIT V APPLICATIONS **9**

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras–human gait analysis Application: In-vehicle vision system: locating roadway – road markings–identifying road signs – locating pedestrians (Ref. Book 2: Chapter 2-5 & Ref. Book 5: All chapters)

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Implement fundamental image processing techniques required for computer vision
2. Calibrate cameras as when required
3. Apply chain codes and other region descriptors
4. Apply Transformation for line, circle, and ellipse detections
5. Develop applications using computer vision techniques

TEXT BOOK:

1. Concise Computer Vision: An Introduction into Theory and Algorithms, Reinhard Klette, 2014, Springer

REFERENCES

1. Introductory Techniques for 3-D Computer Vision, Prentice Hall, 1998.
2. Computer Vision: Algorithms and Applications Richard Szeliski, Springer International, 2011.
3. Computer Vision: a Modern Approach, David Forsyth and Jean Ponce, Prentice Hall, 2009.
4. Multiple View Geometry in Computer Vision, Richard Hartley and Andrew Zisserman, Cambridge, 2001
5. E.R.Davies,"Computer and Machine Vision", Elsevier, 4th edition, 2012

OIT1705 **CYBER SECURITY** **L T P C**

3 0 0 3

OBJECTIVES:

Students should be able to understand

- The difference between threat, risk, attack and vulnerability
- How threats materialize into attacks.
- Where to find information about threats, vulnerabilities and attacks
- Typical threats, attacks and exploits and the motivations behind them.

UNIT I INTRODUCTION TO CYBER SECURITY **9**

Introduction -Computer Security - Threats -Harm - Vulnerabilities - Controls - Authentication - Access Control and Cryptography - Web—User Side - Browser Attacks - Web Attacks Targeting Users - Obtaining User or Website Data - Email Attacks (Ref. Book 1: Chapter 1-3)

UNIT II SECURITY IN OPERATING SYSTEM & NETWORKS 9

Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service. (Ref. Book 1: Chapter 5 and 6- Part I)

UNIT III DEFENCES: SECURITY COUNTERMEASURES 9

Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity - Database Disclosure - Data Mining and Big Data. (Ref. Book 1: Chapter 6 – Part II and Chapter 7)

UNIT IV PRIVACY IN CYBERSPACE 9

Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining -Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies - Where the Field Is Headed. (Ref. Book 1: Chapter 9)

UNIT V MANAGEMENT AND INCIDENTS 9

Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster - Emerging Technologies - The Internet of Things - Economics - Electronic Voting - Cyber Warfare- Cyberspace and the Law - International Laws - Cyber crime - Cyber Warfare and Home Land Security. (Ref. Book 1: Chapter 10 and 13)

TOTAL: 45 PERIODS

OUTCOMES:

At the end the student will be able to

1. Compare threat, risk, attack and vulnerability.
2. Security in the design of operating systems
3. Analyze security counter measures
4. Implement privacy principles and policies
5. Inject secure coding in the developed applications

REFERENCES

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition , Pearson Education , 2015

2. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press, 2013.

3. Martti Lehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015

4. Nelson Phillips and Enfinger Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, New Delhi, 2009.

OIT1706 MACHINE LEARNING AND R PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To analyze data by applying machine learning techniques
- Understand basic constructs in R
- Learning and applying basic classification techniques.
- Learning various black box techniques of classification, market basket analysis and clustering
- Evaluating performance of the models

UNIT I INTRODUCTION **9**

Introduction to Machine Learning – Need of machine learning-Kinds of machine learning – Steps of machine learning – choosing a machine learning algorithm – Using R for Machine Learning-Probability Distributions-Basis Statistics

UNIT II R DATA STRUCTURES **9**

Managing and understanding data – Console input and output – Data Types – operators – Functions - R Data Structures – Vectors – Factors –Lists – Data Frames – Matrices and arrays – import and export files – Exploring and understanding data – Visualization – Categorical variables exploration – Relations between variables

UNIT III LEARNING BY CLASSIFICATION **9**

Classification – Lazy Learner - K-Nearest Neighbor – Probabilistic Learner - Naïve Bayes – Divide and Conquer - Decision Trees and Rule based Learning – Understanding classification rules -Forecasting numerical data – Regression Models – Visualization using Plots - Case Study : Breast Cancer with KNN , Filtering Mobile phone spam using Naïve Bayes , Risky Bank Loans using Decision Trees , Identifying Poisonous Mushrooms with Rules based learners , Predict medical Expense with Linear Regression

UNIT IV BLACK BOX CLASSIFICATION, MARKET BASKET ANALYSIS AND CLUSTERING **9**

Black Box Learning Methods – SVM – Finding Maximum Margin – Using Kernels for non – linear spaces - Neural Networks - Market Basket Analysis – Understanding association rules – Apriori Algorithm – Case Study: Modeling strength of concrete , OCR with SVM, Identification of frequently purchased groceries with apriori

Clustering – K-Means Algorithm-Partitioning Around Medoids (PAM) –Hierarchical Clustering- Case Study – Finding Teen Segments of Market

UNIT V PERFORMANCE EVALUATION **9**

Evaluating Model Performance – Measuring performance for classifier – Beyond Accuracy – Kappa – Sensitivity and Specificity – Precision and recall – F-Measure – Visualization with ROC Curve – Estimate future performance – Improving Model Performance – Tuning stock models for better performance – Improving model performance with meta leaners

TEXT BOOKS:

1. "Machine Learning with R", Brett Lantz, Packt Publishing, First Edition, 2013.
2. "Beginning R: The Statistical Programming Language" , Mark Gardener, Wrox Wiley Publication, First Edition, 2012.
3. "R for Everyone:Advanced Analytics and Graphics",Jared P.Lander,Pearson Education,2015.

REFERENCES:

1. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.
2. http://www.johndcook.com/R_language_for_programmers.html.
3. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013.
4. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd., 2014.

OUTCOMES:

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

1. Understand the applications and uses of machine learning
2. Apply basic constructs in R
3. Apply machine learning by various classification techniques
4. Apply market basket analysis and clustering techniques
5. Evaluate the performance of the models built and fine tune the models to improve them

OPEN ELECTIVE OFFERED BY DEPT OF MECHATRONICS ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OMT1701	Industrial Robotics	OE	3	3	0	0	3
2.	OMT1702	Elements Of Automation	OE	3	3	0	0	3
3.	OMT1703	Bio-mechatronics	OE	3	3	0	0	3
4.	OMT1704	CNC Systems- Design And Applications	OE	3	3	0	0	3
5.	OMT1705	Mobile Robotics	OE	3	3	0	0	3

OMT1701 INDUSTRIAL ROBOTICS

L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on Robot fundamentals
- To impart knowledge on Different sensors and Actuators
- To impart the knowledge on Humanoids and applications

UNIT I INTRODUCTION **6**

Automation and Robotics – Robotics in Science Fiction – History of Robotics – Robotics Market and Future Percepts

UNIT II FUNDAMENTALS OF ROBOT TECHNOLOGY **9**

Robot Anatomy – Work Volume – Robot Drive Systems – Control System – Precision of Movement - Safety- Training – Maintenance - Robot Intelligence – Robot task- Robot Mobility.

UNIT III ACTUATORS AND SENSORS IN ROBOTS **12**

End effectors: Types and Applications - Ultrasonic sensors -Range finding- time of flight LIDAR- triangulation techniques -Vision for 3D measurement - structured lighting stereo vision and camera calibration.

UNIT IV HUMANOIDS **9**

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Tactile Sensing, Models of emotion and motivation.

UNIT V APPLICATIONS **9**

Material transfer, Machine loading, Assembly, NDE inspection & applications, Mobile Robots. Robot safety and robustness, Human activity recognition using vision, touch, sound.

TOTAL : 45 PERIODS

OUTCOMES:

After the completion of this course students will be able to

CO1. Understand the basics of Robotics
CO2. Conclude the fundamentals of Robot terminologies
CO3. Compare the different types of Actuators and Sensors in Robotics
CO4. Analyze the working of Humanoid Robots
CO5. Examine the different applications of robotics

TEXT BOOKS:

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics:Technology, Programming and Applications", McGraw Hill Book Company, 2012
2. Ashitava Ghosal, "Robotics: Fundamental Concepts and Analysis", Oxford University Press, 2008
3. Craig J.J., "Introduction to Robotics: Mechanics and Control", Prentice Hall Inc. / Pearson Education, 2008
4. Jazer R.N., "Theory of Applied Robotics", Springer, 2010

REFERENCES:

1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2004
2. Riadh Siaer, "The future of Humanoid Robots- Research and applications",Intech Publications, 2012.
3. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
4. Kelly, Alonzo, Iagnemma, Karl, Howard, Andrew, "Field and Service Robotics ", Springer, 2011

OMT1702 ELEMENTS OF AUTOMATION L T P C
3 0 0 3

OBJECTIVES:

- Understand the fundamental knowledge of various elements of automation.
- Understand the need for automation in process industries.
- To impart basic knowledge of sensors and actuators
- To apply the fundamental knowledge of hydraulic and pneumatic system
- To provide a clear view on Programmable Logic Controllers (PLC) and its application

UNIT I INTRODUCTION TO AUTOMATION 9

Automated manufacturing systems - fixed /programmable /flexible automation - Need of automation, Basic elements of automated systems- power, program and control. Levels of automation; control systems: Continuous and discrete control; Low cost automation, Economic and social aspects of automation.

UNIT II SENSORS AND TRANSDUCERS 9

Introduction to sensors and transducers - Static and dynamic characteristics-Types - Displacement, position and proximity - velocity and motion - force - fluid pressure - liquid flow and level - Temperature - Light - Selection of sensors.

UNIT III BASICS OF PNEUMATICS AND HYDRAULICS SYSTEM 9

Operational principles and application, air compressors, Pneumatic cylinders and air motors, Pneumatic valves, Design of pneumatic circuits. Principles of hydraulics, Hydraulic fluids, Hydraulic- pumps, valves, and actuators. Power pack design layout, Basic hydraulic circuits.

UNIT IV MECHANICAL AND ELECTRICAL ACTUATION SYSTEMS 9

Mechanical actuation System: Mechanical system - types of motion - Kinematic chain - cams - Gear Trains - Ratchet and pawl - Belt and chain drives - Bearings - Mechanical aspects of Motor selection. Electrical actuation system: Electrical Systems - Mechanical switches - Solid state switches - Solenoids - Stepper motor

UNIT V PROGRAMMABLE LOGIC CONTROLLER 9

Introduction - Basic structure - Input/output processing - programming - Mnemonics - Timers, relays and counters - Shift registers - Data handling - Analogue input/output - Selection of PLC - Simple problems

TOTAL : 45 PERIODS

OUTCOMES:

After the completion of this course students will be able to

CO1. Understand the fundamentals of automation system.
CO2. Classify and infer various types of sensors and transducers
CO3. Demonstrate various applications of hydraulic and pneumatic systems.
CO4. Illustrate the operations of mechanical and electrical actuation systems.
CO5. Acquire basic knowledge on PLC for various applications.

TEXT BOOKS:

1. Bolton W., Mechatronics: electronic control systems in mechanical and electrical engineering, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2013
2. Anthony Esposito, "Fluid Power with applications", Prentice Hall international, 2009.
3. Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing" Pearson Education, New Delhi, 2008.

REFERENCES

1. Kuo .B.C, "Automatic control systems", Prentice Hall India, New Delhi, 2007.
2. Bagad V. S., Mechatronics, Technical Publication, Pune, 2009.
3. Devdas Shetty and Richard A. Kolk, Mechatronics System Design, Cengage Delmar Learning India Pvt Learning, 2012.

OMT1703 BIOMECHATRONICS L T P C
3 0 0 3

OBJECTIVES:

- To get the clear understanding of Mechatronical principles in medicine.
- To provide an exposure on types of mechanisms and artificial intelligence.
- To learn the different Mechatronic Medical Application used in real time.

UNIT I INTRODUCTION TO MECHATRONICS AND SENSORS 10

Introduction – Mechatronic System – Design Concept and Framework – Importance of Mechatronics in Medical applications – Transducer and Sensors – Machine Vision – Sensor applications in Medical applications.

UNIT II MECHANISMS AND MECHANICAL DEVICES 10

Introduction – Conversion of linear and Rotational Motion and vice versa – Changing rotational speed, Torque, and angular orientation of rotational motion – Clutches and Brakes – Bearings.

UNIT III ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 10

Introduction – Artificial Intelligence – Expert Systems – Artificial Neural Network – Fuzzy Systems – Neuro – Fuzzy Systems.

UNIT IV APPLICATIONS OF MECHATRONICS IN MEDICINE 10

Introduction – Medical Imaging application – Robotics in Medicine – Smart instruments and Probes – Navigation.

UNIT V MECHATRONIC MEDICAL CASE STUDIES 5

Handheld Snake Like Robots – Smart Probe for Detecting Kidney Stones – Active Prosthetic Knee – Smart System for cardiovascular Plaque Detection – Ankle Sprain.

TOTAL: 45 PERIODS

OUTCOMES:
After the completion of this course students will be able to

CO1. Understand the concepts of Mechatronics system and types of sensors used in Medical Applications.
CO2. The students will understand the types of Mechanisms.
CO3. Demonstrate the concepts of the artificial Intelligence.
CO4. Acquire implementation of mechatronic system for real time Medical applications.
CO5. Understand the concepts of the Medical Mechatronic systems by means of real time case studies.

TEXT BOOKS:

1. Siamak Najarian, Javad Dargahi, Ph.D.,, Goldis Darbemamieh, Siamak Hajizadeh Farkoush, “Mechatronics in Medicine: A Biomedical Engineering Approach”, McGraw Hill Education, 2012.

REFERENCES:

1. ŽIVČÁK, J. Základy bioniky a biomechaniky. Prešov : ManaCon, 2004. 256 p. ISBN 80-89040-25-X.
2. Dawson D and Right, "Introduction to Bio-mechanics of Joints and Joint Replacement", Mechanical Engineering Publications Ltd., 1989.

OMT1704 CNC SYSTEMS- DESIGN AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- Understand evolution and principle of CNC machine tools
- Describe constructional features of CNC machine tools
- Generate CNC programs for popular CNC controllers
- Describe machine tools and work holding devices for CNC machine tools

UNIT I INTRODUCTION 9

Introduction to Automation – Goals of Automation, levels of automation, Hard Vs Soft Automation, Computer Aided manufacturing (CAM). Evolution of CNC Technology - Numerical Control - Introduction, Role of NC / CNC in CAM, Applications of NC / CNC, Benefits of NC / CNC, Limitations of CNC.

UNIT II COMPONENTS OF CNC SYSTEM 9

Basic Components of CNC system - Part programming, Machine control unit, Machine tool - Historical developments and their role in control of machine tools, Classification of NC / CNC systems - Based on type of Control (PTP\C\L), method of programming, type of architecture - Hardwired / Softwired / Open.

UNIT III INTERPOLATORS AND CONTROLLERS 9

Machine Control Unit - Data processing Unit - elements and their functions - Interpolators and Sequential Controllers. Interpolators - Types and Stages of Interpolation, Principles of interpolation - Techniques employed for Interpolation Scheme. Sequential controllers - Concepts, Relay ladder diagrams and their development. Programmable Logic Controllers - Elements of Hardware and Software, Methods of programming.

UNIT IV PART PROGRAMMING 9

Part programming - Introduction; Part Program and its elements, Methods of Programming - Manual and Computer Assisted Part programming - Custom Macro (Parametric Programming), APT and its variations, Concepts of CAM - Tool path generation and control methods.

UNIT V MACHINE TOOLS 9

Machine Tool - Components of CNC machine tool, Drives and controls, Automatic Tool Changers, Automatic Pallet Changers, tool offsets and work offsets, high speed and precision machining concepts- work holding devices.

TOTAL: 45 PERIODS

OUTCOMES:

After the completion of this course students will be able to

CO1. Explain the fundamentals of CNC machines, differentiate the advantages and disadvantages of different types of CNC machines
CO2. Recognise the basic structure, construction, working and control of CNC machines
CO3. Develop a CNC Part programming for the basic operations
CO4. Classify different types of interpolators and controllers
CO5. Be familiar with different machine tools and work holding devices of CNC

TEXT BOOKS

1. Koren Y, "Computer Control of Manufacturing systems", McGraw Hill, 2017.
2. Alan Overby "CNC Machining Handbook: Building, Programming, and Implementation" McGraw-Hill Education, 2010

REFERENCES

1. Reinbold U, Blume C and Dilmann R, "Computer Integrated Manufacturing Technology & Systems", Marcel Dekker, 1985.
2. John W, "Programmable Controllers - Principles and Applications" Merrill Publ.Co, New York, 1980.
3. Madison J, "CNC machining Handbook", Industrial Press Inc., 1996.
4. Barry Leatham - Jones, Introductions to Computer Numerical Control, Pitman, London - John willey & Sons, 1986.
5. Roger S. Pressman & John E. Williams, Numerical Control and Computer Aided Manufacturing, John Willey.

OMT1705 MOBILE ROBOTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge about the basics and constraints in Mobility for Robots
- To study about the different sensors integrated with mobile robots
- To observe about the Path determination and observance of the Robot environment
- To study about the different controlling strategies for Mobile Robots
- To expose the different application areas of Mobile Robotics

UNIT I INTRODUCTION TO MOBILE ROBOTS 9

Introduction – History – Configuration Space - Motion Constraints – Kinematics of wheeled Mobile Robots – Dynamics of Mobile Robots with Constraints – Mobile Robot Safety.

UNIT II MOBILE ROBOT SENSORS 9

Position Sensor – Velocity Sensor – Distance Sensor – Robot Vision – Optical Gyroscope – Compass – GPS.

UNIT III ROBOT LOCALIZATION AND MOTION PLANNING 9

Relative Localization – Absolute Localization – Simultaneous Localization and Mapping - Operation of Robot Navigation – Classification of Path Planning Methods – Model Based Robot Path Planning – Mobile Robot Motion Planning – Mobile Robot Task Planning.

UNIT IV MOBILE ROBOT CONTROLLERS 9

General Robot Controllers - Sliding Mode Control of Mobile Robot – Fuzzy Control for Mobile Robot – Position Based Vision Control – Image Based Vision Control

UNIT V APPLICATIONS OF MOBILE ROBOTS 9

Mobile Robot in Factory Automation – Mobile Telerobots – Micro Mobile Robots - Research Robots – War Robots – Assistive Mobile Robots in Walking Rehabilitation Therapy – Mobile Robots for Home Services.

TOTAL: 45 PERIODS

OUTCOMES:

After the completion of this course students will be able to

CO1. Understand the basics of Mobility in Robots along with its constraints
CO2. Compare the sensor performances and able to choose appropriate sensor based upon the requirement
CO3. Perform Localization of Mobile Robot and its Path Planning.
CO4. Analyze the performances of different Controllers in Mobile Robots
CO5. Understand the different areas of Applications of Mobile Robots

TEXT BOOKS:

1. Spyros G Tzafestas, “Introduction to Mobile Robot Control”, Elsevier, 2014
2. Gregor Klancar, Andrej Zdesar, Saso Blazic, Igor Skrjanc, “Wheeled Mobile Robotics: From Fundamentals Towards Autonomous Systems”, Butterworth Heinemann, 2017

REFERENCES:

1. Kevin M. Lynch, Frank C. Park, “Modern Robotics”, Cambridge University Press, 2017
2. Everett H.R., “Sensors for Mobile Robots”, CRC Press, 2010
3. Carlotta A. Berry, “Mobile Robotics for Multidisciplinary Study”, Morgan and Claypool, 2012

OPEN ELECTIVES OFFERED BY DEPT. OF MECHANICAL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OME1701	Design of Experiments	OE	3	3	0	0	3
2.	OME1702	Industrial Safety	OE	3	3	0	0	3
3.	OME1703	Quality Concept	OE	3	3	0	0	3
4.	OME1704	Fundamentals of Production Engineering	OE	3	3	0	0	3
5.	OME1705	Supply chain and Logistics Management	OE	3	3	0	0	3
6.	OME1706	Fundamentals of Mechanical Engineering	OE	3	3	0	0	3

OME1701 **DESIGN OF EXPERIMENTS** **L T P C**
3 0 0 3

OBJECTIVES:

- To be able to plan an experiments in such a way that the statistical results in valid and meets the objective.
- To learn a variety of experimental designs and be able to choose an appropriate design for a specific study
- To learn to perform the proper statistical analysis and draw valid conclusions from a specific experiments.
- To know the formulation of the design of experiment model for the industry problems
- To learn to design a system

UNIT I BASICS OF EXPERIMENTAL DESIGN 6

Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression models

UNIT II SINGLE FACTOR EXPERIMENTS 10

Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.

UNIT III MULTIFACTOR EXPERIMENTS 10

Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F- tests. 2^K factorial Experiments

UNIT IV SPECIAL EXPERIMENTAL DESIGNS 9

Blocking and confounding in 2^K designs. Two level Fractional factorial design, nested designs, Split plot design, Response Surface Methods, Robust Parameter Designs – Case Studies

UNIT V TAGUCHI METHODS 10

Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi-response optimization – Case Studies

TOTAL : 45 PERIODS

OUTCOMES:

- Able to know the basic concepts and models of experimental design
- Able to formulate the experimental design model for the real time industrial problemand analyse the results of a designed experiments in order to conduct the appropriate statistical analysis of the data.
- Able to interpret the statistical results from an experiment
- Able to apply design of experiment techniques to any real time industrial problems and to optimize the performance of industries.

TEXTBOOKS:

1. Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI learning private Ltd., 2012.
2. Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, Eighth edition, 2012.

REFERENCE:

1. Nicolo Belavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.
2. Phillip J. Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996.
3. Montgomery, D.C., Design and Analysis of Experiments, Minitab Manual, John Wiley and Sons, Seventh edition, 2010.

OME1702 INDUSTRIAL SAFETY L T P C
3 0 0 3

OBJECTIVES:

- To provide in-depth knowledge in principles of Industrial safety and its significance in various fields.
- To provide the knowledge of safety at various levels in the industry such as operational, assessment of earn the CAD modeling and basic process steps of digital work flow from design to Manufactured AM parts
- To enrich about the regulations of safety and health regulations with case study
- To expose the health hazard due to various industries
- To provide knowledge on safety management in industry at various level

UNIT I OPERATIONAL SAFETY 9

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation – safety in machine shop – cold bending and chamfering of pipes- metal cutting – shot blasting, grinding, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety of sewage disposal and cleaning – control

of environmental pollution – managing emergencies in industries – planning security and risk assessments, on – site and off site. Control of major industrial hazards.

UNIT II SAFETY APPRAISAL AND ANALYSIS 9

Human side of safety – personal protective equipment – causes and cost of accidents. Accidents prevention program – specific hazard control strategies – HAZOP training and development of employees – first aid – fire fight devices – accident reporting, investigation. Measurement of safety performance, accident reporting and investigation – plant safety inspection, job safety analysis – safety permit procedures. Product safety – plant safety rules and procedures – safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.

UNIT III OCCUPATIONAL HEALTH 9

Concept and spectrum of health functional units and activities of operational health service – occupational and related diseases – levels of prevention of diseases – notifiable occupational diseases – Toxicology – Lead, Nickel, Chromium and Manganese toxicity – gas poisoning - effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT IV SAFETY AND HEALTH REGULATIONS 9

Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.

UNIT V SAFETY MANAGEMENT 9

Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety –safety education and training to workers - safety and productivity

TOTAL :45 PERIODS

OUTCOMES:

- Able to know the various safety measures to be followed in various industries
- Able to evaluate and analyse the safety of industry to determine the cost effectiveness
- Able to know the industry related health hazard due to various types of industries.
- Able to know the environmental and industrial safety act 1948
- Able to evaluate the safety measures to ensure safety.

TEXTBOOKS:

1. John.V .Grimaldi and Rollin. H Simonds, “Safety Management”, All India traveler book seller, New Delhi, 1989
2. Krishnan N.V, “Safety in Industry”, Jaico Publisher House, 1996.

REFERENCE TEXTBOOKS:

1. U.K singh & J.M Dewam, “Safety security and Risk management”, A.P.H. publishing Company, New Delhi, 1996.
2. John V Grimaldi, “Safety Management”, AITB publishers, 2003.
3. Occupational Safety Manual, BHEL.

OME1703 **QUALITY CONCEPT** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide in depth knowledge in principles of quality and its significance.
- To provide the knowledge of control chart for variables, their relevance, methodologies and benefits.
- To provide the knowledge of control chart for attributes, their relevance, methodologies and benefits.
- To enrich about the need, types, procedure and applications acceptance sampling.
- To provide knowledge on reliability and its usefulness in industry.

UNIT I INTRODUCTION TO QUALITY 9

Introduction, definition of quality, basic concept of quality, Quality assurance, Quality control, Quality costs – measuring quality costs, Variation in process – causes of variation, Statistical quality control – benefits and limitation of statistical quality control.

UNIT II CONTROL CHARTS FOR VARIABLES 9

Theory of control chart – uses of control chart – Control chart for variables – X chart, R chart and sigma chart – process capability – process capability studies – problems. Six sigma concepts.

UNIT III CONTROL CHARTS FOR ATTRIBUTES 9

Control chart for attributes – control chart for non conforming – p chart and np chart – control chart for non conformities – C and U charts, State of control and process out of control identification in charts – simple problems

UNIT IV ACCEPTANCE SAMPLING 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer"s risk and consumer"s risk. AQL, LTPD, AOQL concepts – standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT V RELIABILITY ENGINEERING 9

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. O.C Curves – Reliability improvements techniques – use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability

TOTAL : 45 PERIODS

OUTCOMES:

- Able to know the basic aspects of quality to be followed in various industries
- Able to plot, evaluate and interpret the control chart for variables.
- Able to plot, evaluate and interpret the control chart for attributes.
- Able to carry out acceptance sampling and analyse and interpret the results of acceptance sampling.
- Able to evaluate the reliability of simple and complex systems.

TEXTBOOKS:

1. Douglas,C, Montgomery, " Introduction to Statistical quality control", 4th edition, John Wiley 2001.
2. Grant, Eugene .L, "Statistical Quality Control", McGraw-Hill, 1996
3. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
4. Naikan, V.N.A, "Reliability Engineering and Life Testing", Prentice Hall of India, 2008.

REFERENCE:

1. John,S, Oakland. "Statistical process control", 5th edition, Elsevier, 2005
2. Grant, Eugene, L "Statistical Quality Control", McGraw-Hill, 1996
3. Gupta, R.C, "Statistical Quality control", Khanna Publishers, 1997.
4. Besterfield, D.H., "Quality Control", Prentice Hall, 1993.
5. Sharma, S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.
6. Srinath, L.S., "Reliability Engineering", Affiliated East west press, 1991.

OME1704 FUNDAMENTALS OF PRODUCTION ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- The automobile components such as piston, connecting rod, crankshaft, engine block, front axle, frame, body etc., are manufactured by various types of production processes involving casting, welding, machining, metal forming, power metallurgy etc.

UNIT I CASTING 8

Casting types, procedure to make sand mould, types of core making, moulding tools, machine moulding, special moulding processes – CO2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects.

UNIT II WELDING 8

Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing.

UNIT III MACHINING 13

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan and Turret lathe. Basics of CNC machines. General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, Electron beam machining and Laser beam machining.

UNIT IV FORMING AND SHAPING OF PLASTICS 7

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods.

UNIT V METAL FORMING AND POWDER METALLURGY 9

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy.

TOTAL: 45 PERIODS

OUTCOMES:

- The Students can able to use different manufacturing process and use this in industry for component production

TEXT BOOKS:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2. Nagendra Parashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice-Hall of India Private Limited, 2007.

REFERENCES :

1. Serope Kalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials", Fourth Edition, Pearson Education, Inc. 2007.
2. Jain. R.K. and S.C. Gupta, "Production Technology", Khanna Publishers. 16 th Edition,2001.
3. "H.M.T. Production Technology – Handbook", Tata McGraw-Hill, 2000.
4. Roy. A. Linberg, "Process and Materials of Manufacture", PHI, 2000.
5. Adithan. M and Gupta. A.B., "Manufacturing Technology", New Age, 2006.

OME1705 SUPPLY CHAIN AND LOGISTICS MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To understand the role of logistics and supply, Competitive and Supply chain Strategies and Drivers of Supply Chain
- To understand about the distribution networks, network Design and Transportation in Supply Chain.
- To learn about Sourcing and coordination in Supply Chain
- To understand about supply chain IT framework and emerging issues in supply chain

UNIT I INTRODUCTION TO SUPPLY CHAIN AND LOGISTICS MANAGAMENT 9

Define Supply chain and logistics management; Scope and its Importance - Evolution of Supply Chain –Examples of supply Chains - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles – supply chain relationship Logistics Management –functions, objectives

UNIT II SUPPLY CHAIN NETWORK DESIGN 9

Role of Distribution in Supply Chain – Factors influencing Distribution network design –Design options for Distribution Network- Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions - Impact of uncertainty on Network Design. Network Design decisions using Decision trees.

UNIT III LOGISTICS IN SUPPLY CHAIN 9

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation -3PL- 4PL-Global Logistics - Reverse Logistics; Reasons, Activities and issues;

UNIT IV SOURCING AND COORDINATION IN SUPPLY CHAIN 9

Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis -supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain - Analyzing impact of supply chain redesign on the inventory

UNIT V IT AND EMERGING CONCEPTS IN SUPPLY CHAIN 9

The role IT in supply chain-The supply chain IT framework -Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain

Introduction to Warehouse Management, Risk in Supply Chain, Lean supply Chains, Sustainable supply Chains

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand the framework and scope of supply chain networks and functions.
- Ability to design Distribution, Transportation and network design principles in a selected enterprise.
- Ability to understand Sourcing and Coordination in SCM.
- Ability to apply SCM concepts in a selected enterprise.
- Ability to understand role of Information Technology in SCM and emerging concepts in SCM.

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl and D.V. Kalra, “Supply Chain Management: Strategy, Planning, and Operation, ,Pearson Education, 2013.
2. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management”, PHI, 2010.
3. A. Ravi Ravindran, Donald P. Warsing, Jr”, Supply Chain Engineering: Models and Applications, “CRC Press, 2012.
4. Senthil Kumar ,Omkumar.M, “Warehouse layout Planning and Part Feeding Methods”, Yesdee, 2014.
5. Sople Vinod V, Logistics Management, Pearson Education, 2010.

OME1706 FUNDAMENTALS OF MECHANICAL ENGINEERING **L T P C**
3 0 0 3

Course objectives:

- Students belonging to all branches of Engineering are made to learn certain fundamental topics related to mechanical engineering so that they will have a minimum understanding of mechanical systems, equipment and process.

UNIT – I MACHINE TOOLS AND OPERATIONS 9

Turning, facing, knurling, Thread cutting, Taper Turning by swivelling the compound rest, Drilling, Boring, Reaming, Tapping, Counter Sinking, Counter Boring, -Plane milling, End milling, Slot milling. (No sketches of Machine tools, sketches to be used only for explaining operations. Students to be shown the available machine tools in the Machine Shop of the college before explaining the operations).

UNIT – II ENGINEERING MATERIALS AND JOINING PROCESSES 9

Engineering Materials: Types and applications of Ferrous & Nonferrous metals and alloys, Composites: Introduction: Definition, Classification and applications (Air craft and Automobiles).

Joining Process: Soldering, Brazing and Welding: Definitions, classification and method of soldering, Brazing and welding. Differences between soldering, Brazing and Welding. Description of Electric Arc Welding and Oxy-Acetylene Welding.

UNIT – III INTERNAL COMBUSTION ENGINES 9

Classification, I.C. Engines parts, 2 Stroke and 4 stroke Petrol engines, 4 stroke diesel engines. P-V diagrams of Otto and Diesel cycles. Problems on indicated power, brake power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, and specific fuel consumption.

UNIT – IV TURBINES AND PUMPS STEAM TURBINES 9

Classification, Principle of operation of Impulse and reaction turbines, Delaval's turbine, Parson's turbine. (No compounding of turbines). Gas turbines: Classification, Working principles and Operations of Open cycle and closed cycle gas turbines. Water turbines: Classification, Principles and operations of Pelton wheel, Francis turbine and Kaplan turbine.

UNIT – V REFRIGERATION AND AIR-CONDITIONING 9

Refrigerants: Properties of refrigerants, list of commonly used refrigerants. Refrigeration –Definitions – Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, Relative COP, unit of Refrigeration. Principle and working of vapor compression refrigeration and vapor absorption refrigeration: Principles and applications of air conditioners, Room air conditioner.

Total: 45 Periods

Course outcomes:

Students shall demonstrate knowledge associated with:

- Metal removal and joining process
- Boilers, Prime movers such as turbines and IC engines, refrigeration and air-conditioning systems
- Metal removal process using Lathe, drilling, Milling Robotics and Automation.
- Fair understanding of application and usage of various engineering materials.
- Principle operation of Refrigeration and Air-Conditioning systems**.**

Text Books:

1. K.R.Gopalakrishna , Sudhir Gopalakrishna and S.C. Sharma. A Textbook of Elements of Mechanical Engineering, Subhash Publishers, 2016.

References:

1. P.C. Sharma, A Text book of Production Technology, S Chand Publisher, 2014.
2. V Ganesan, Internal Combustion Engines, 4th Edition, McGraw Hill Publishers, 2017.
3. C P Arora, Refrigeration and Air Conditioning, McGraw Hill Publishers, 2017.

OPEN ELECTIVE OFFERED BYDEPT OF HUMANITIES AND SCIENCE

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OMA1701	Computer based Numerical methods	OE	4	2	0	2	3
2.	OMA1702	Number theory and applications	OE	3	3	0	0	3
3.	OPH1701	Materials Synthesis and Characterization Techniques	OE	3	3	0	0	3
4.	OPH1702	Nanophysics	OE	3	3	0	0	3
5.	OCY1701	Green Chemistry in Energy and Environment	OE	3	3	0	0	3
6.	OCY1702	Interface Chemistry and Engineering	OE	3	3	0	0	3

GENERAL OPEN ELECTIVES

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OGE1701	Human Rights	OE	3	3	0	0	3
2.	OGE1702	Foreign Language-Japanese	OE	3	3	0	0	3
3.	OGE1703	Foreign Language-German	OE	3	3	0	0	3
4.	OGE1704	Foreign Language-French	OE	3	3	0	0	3
5.	OGE1705	PROGRAMMING LOGIC	OE	3	2	0	2	3
6.	OGE1706	ADVANCED PROGRAMMING LOGIC	OE	3	2	0	2	3

OMA1701 COMPUTER BASED NUMERICAL METHODS L T P C
2 0 2 3

OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations: Iterative method - Gauss Seidel - Eigen values of a matrix by Power method – algorithms and programs.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange's interpolation – Newton’s divided difference interpolation - Interpolation with equal intervals - Newton’s forward and backward difference formulae- algorithms and programs.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules –algorithms and programs.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single Step methods - Taylor's series method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi step method - Milne's predictor corrector methods for solving first order equations – algorithms and programs.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method – algorithms and programs.

TOTAL 60 PERIODS

OUTCOMES

On completion of the course students will be able

- to solve algebraic equations and eigen value problems that arise during the study of Engineering problems.
- to use various interpolation techniques for solving problems in Engineering.
- to use numerical methods to solve problems involving numerical differentiation and integration.
- to solve initial value problems numerically that arise in Science and Engineering.
- to solve boundary value problems that encounter in different fields of Engineering study.

TEXTBOOKS

1. Veerarajan. T, " Numerical methods with programs in C,"Tata McGraw Hill, New Delhi, 2007.

REFERENCES:

1. Chapra. S.C., and Canale.R.P., "Numerical Methods for Engineers, Tata McGraw Hill, 5 th Edition, New Delhi, 2007.
2. Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi, 2007.
3. Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of India Private, 3 rd Edition, New Delhi, 2007.
4. Grewal. B.S., and Grewal. J.S.,"Numerical methods in Engineering and Science", Khanna Publishers, 9th Edition, New Delhi, 2007.

5. Gerald. C. F., and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
6. Goyal, M, "Computer Based Numerical and Statistical Techniques", Firewall Media, New Delhi.

OMA1702 NUMBER THEORY AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- This course aims at providing the necessary basic concepts of number theory and the relevant topics of cryptography as an application of Number theory.

UNIT I DIVISIBILITY THEORY 9

Division algorithm- Base-b representations – number patterns – Prime and composite numbers – Fibonacci and Lucas numbers – Fermat numbers

UNIT II GREATEST COMMON DIVISOR 9

Greatest Common Divisor– Euclidean Algorithm – Fundamental theorem of Arithmetic – Least Common Multiple – Linear Diophantine Equations

UNIT III CONGRUENCE AND APPLICATIONS 9

Congruences – Linear Congruences– Divisibility tests – Modular Designs–Chinese remainder theorem – 2x2 linear systems.

UNIT IV CLASSICAL THEOREMS 9

Wilson's theorem – Fermat's Little theorem – Pseudo Primes –Euler's theorem.
(theorems without proof)

UNIT V CLASSICAL CRYPTOSYSTEMS 9

Classical cryptosystems, Enciphering matrices, Public key Cryptography, RSA**.**

TOTAL PERIODS:45

OUTCOMES:

On completion of the course students will be able to

- use the applications of division in computations.
- apply the Euclidean Algorithm.
- solve linear Diophantine equations.
- apply the classical theorems in Number Theory.
- apply the concepts of Number Theory in cryptosystems.

TEXT BOOKS:

1. Thomas Koshy, "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002.
2. T. Veerarajan, " Discrete Mathematics with Graph Theory and combinatorics", McGraw Hill Publications.

REFERENCES:

1.Kenneth H Rosan, "Discrete Mathematics and its applications", 7th Edition, McGraw Hill Publications, 2012.

2. Niven.I, Zuckerman.H.S., and Montgomery, H.L., "An Introduction to Theory of Numbers" , John Wiley and Sons, Singapore, 2004.

OPH1701 MATERIALS SYNTHESIS AND CHARACTERIZATION TECHNIQUES L P T C
3 0 0 3

COURSE OBJECTIVE

- Students will be able to understand the various techniques used for synthesizing and characterizing materials for various applications in Mechanical, Civil, Biomedical, Electrical and Electronic Engineering fields.

Unit – I Crystal Growth Techniques 9

Solution growth – low temperature -Supersaturation – Nucleation – Seeding – dopants – Melt growth – Czochralski method – Bridgman method – S-R Method of growing bulk single crystals–NLO crystals - Applications

Unit – II Nanomaterials Preparation Techniques 9

Two main approaches in nanotechnology -Bottom up technique and top down technique - Ball milling, Sputtering, Vapour deposition - pulsed laser deposition – chemical vapour deposition, sol-gel -Nano-structures – quantum wires, quantum wells, quantum dots, quantum clusters - Carbon nano-tubes - Applications

Unit – III Ceramic Materials Preparation Techniques 9

Types of Ceramics - Crystalline - Non Crystalline - Bonded ceramics, Manufacturing methods - Slip casting - Isostatic pressing - Gas pressure bonding - Properties - thermal, mechanical, electrical and chemical - Ceramic fibres - ferroelectric and ferromagnetic ceramics - Applications

Unit – IV Structural Analysis 9

X-ray Diffraction – Single crystal and Powder diffraction – Electron microscopy - SEM – TEM– AFM – Advantages and limitations

Unit – V Thermal and Spectroscopic Studies 9

Thermal studies - Thermo Gravimetry – Differential Thermal Analysis – Differential Scanning Calorimetry – Specific Heat Capacity Analysis – UV-Vis Spectroscopy - FTIR Spectroscopy – FT-Raman Spectroscopy - Interpretation of results - Advantages and limitations

Total : 45 hours

OUTCOMES:

On completion of the course students will be able to

- use various techniques for growing crystals of different materials
- identify suitable methods for synthesizing nanomaterials for various applications
- classify ceramics based on their properties and identify suitable preparation techniques and applications
- apply the knowledge of various structural analysis techniques
- utilize thermal and spectroscopic techniques to characterize materials

Text Books:

1. T. Pradeep, "A Textbook of Nanoscience and Nanotechnology", McGraw Hill, 2016
2. Skoog DA, Holler FJ and Nieman TA, "Principles of Instrumental Analysis", Barace College Publishing, DC, 2006
3. Budinski, K.G. &Budinski, M.K. "Engineering Materials Properties and Selection",Prentice Hall, 2009

Reference:

1. Willard HH, Merritt LL, Dean JA and Settle FA, "Instrumental Methods of Analysis", CBS Publishers and Distributors, New Delhi,
2004.
2. Michel Barsoum, "Fundamentals of Ceramics", CRC Press, 2002.

OPH1702 NANOPHYSICS LPTC

3 0 0 3

COURSE OBJECTIVE:

- Understand the principles of nanophysics
- Synthesize, characterize, and apply nanomaterials in various engineering fields

Unit – I Basics of Nanoscience 9

Nano – definition - Scientific revolution - Atomic Structure and atomic size, emergence and challenges of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro&macro, size effects and crystals, large surface to volume ratio, surface effects on properties.

Unit – II Nanostructures and Properties 9

Quantum Dots – One dimensional - two dimensional - three dimensional nanostructured materials - Quantum clusters of metals – Nano-crystals –Anisotropic nanomaterials – Nano-composites – Properties– Electrical – Magnetic – Optical - bandgap engineering

Unit – III Synthesis of Nanomaterials 9

Two main approaches in nanomaterial synthesis -Bottom up and top down technique – Ball milling – Sputtering - Vapour deposition - pulsed laser deposition – chemical vapour deposition -Sol-gel - Spin coating - Thin films – Epitaxy - Advantages and limitations – Challenges and issues

Unit – IV Characterization of Nanomaterials 9

Particle size identification – Powder X-Ray Diffraction – Debye-Scherrer method – Morphological studies – Scanning electron microscopy– Transmission electron microscopy– Atomic force microscopy – Composition analysis – Energy Dispersive X-ray Analysis (EDAX) – Advantages and limitations.

Unit – V Engineering Applications of Nanomaterials 9

Nano-transistors – Molecular electronics – Single Electron Transistor – Nano-magnetism – Nano-fluids – Cooling techniques – Rheological fluids –Catalysis using metal nanoparticles – Nano drug delivery systems – Nanoelectromechanical Systems (NEMS) – Nano-sensors – Environmental remedial applications

Total: 45 hours

OUTCOMES:

On completion of the course students will be able to

- understand the scientific history and evolution of nanoscience and nanotechnology
- understand the properties of various nanostructures that results from size reduction
- identify suitable synthesis techniques for various nanomaterials and nanostructures
- investigate the size, structure and composition of various nanomaterials
- apply the knowledge of nanophysics in various engineering fields like electrical, mechanical, automobile, biomedical, and/or civil engineering.

Text Books:

1. T. Pradeep, "A Textbook of Nanoscience and Nanotechnology", McGraw Hill, 2016.
2. C.N.R.Rao, A.Muller, A.K.Cheetham (Eds), The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH VerlagGmbh&Co, Weinheim, 2004.

Reference:

1. G. Cao, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press, 2004.
2. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2008.
3. Charles P. Poole, "Introduction to Nanotechnology", John Wiley & Sons, 2003.

OCY1701 GREEN CHEMISTRY IN ENERGY AND ENVIRONMENT **L T P C**
3 0 0 3

OBJECTIVES:

- To acquire knowledge on the principles of green chemistry, synthesis and applications of bio-inspired green nanomaterials,
- To obtain knowledge on microbial fuel cells, and hydrogen energy.

UNIT I INTRODUCTION TO GREEN CHEMISTRY **9**

Green chemistry–definition–principles of green chemistry–green chemistry metrics– atom economy- E factor- reaction mass efficiency and other green chemistry metrics–application of green metrics analysis to synthetic plans–Waste: Production-problems-prevention.

UNIT II GREEN CHEMICAL REACTIONS 9

Environmentally benign processes–alternate solvents–supercritical solvents–ionic liquids–water as a reaction medium–energy efficient design of processes–photo- electro- sono chemical methods–microwave assisted reactions. Green reagents and catalysis in green synthesis.

UNIT III BIO-INSPIRED GREEN NANOMATERIALS 9

Bio-inspired green nanomaterials –biosynthesis of nanoparticles by bacteria and fungi – biosynthesis of nanoparticles using plant extracts – advantages - applications.

UNIT IV MICROBIAL FUEL CELLS 9

Introduction – materials for microbial fuel cells –principles, working and applications – wastewater treatment – energy generation – sensors.

UNIT V HYDROGEN ENERGY 9

Hydrogen – physical and chemical properties- characteristics–production of hydrogen – Electrochemical: electrolysis, photo electro chemical. Biological: photo biological, anaerobic digestion. Hydrogen storage options – compressed gas –chemical hydride–cryogenic storage–Nanostructures for efficient solar hydrogen production–metal nano clusters in hydrogen storage applications.

TOTAL HOURS : 45

OUTCOMES:

On completion of the course students will be able to

- familiarize with the principles of green chemistry.
- apply green chemical approaches in the manufacture of materials.
- synthesize biogenic nanomaterials.
- develop microbial fuel cells.
- acquaint with the production of hydrogen energy.

TEXTBOOKS:

1. Ahluwalia, V. K., Kidwai M. New trends in green chemistry, Anamaya Publishers, New Delhi, India (2004).
2. Basu, S. (Ed) Recent Trends in Fuel Cell Science and Technology, Springer-Verlag New York (2007).

REFERENCE BOOKS:

1. Alexi Lapkin and david Constable (Eds),Green chemistry metrics, Wiley, John & Sons, Incorporated (2008).
2. Ahluwalia. V.K, Green Chemistry, Environmentally Benign Reactions, CRC Press, Boca, Raton, 2nd Edition(2012).
3. Vladimir A. Basiuk, Elena V. Basiuk, Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials,Springer International Publishing Switzerland, (2015).
4. Keith Scott and Eileen Hao Yu(Eds), Microbial Electrochemical and Fuel Cells, Fundamentals and Applications, 1st Edition, Woodhead Publishing (2016).
5. B. Sorensen, G. Spazzafumo, Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier, Academic Press (2018).

OCY1702 INTERFACE CHEMISTRY AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To acquire knowledge on basic principles of interface chemistry, basic concepts of colloidal particles, and applications of surfactants, emulsions and gels.
- To acquire knowledge on biosensors, corrosion and its surface modification techniques.

UNIT I SURFACES AND INTERFACES 9

Types of interfaces- liquid surfaces- curved interfaces-young -laplace and kelvin equations; capillary condensation; surface tension; solid-liquid interfaces-contact angle and wetting-solid surfaces-external and internal surfaces-homogeneous and heterogeneous surfaces. Solid-gas interfaces-types of adsorption-adsorption isotherms – langmuir,and BET.

UNIT II COLLOIDAL SCIENCE 9

Introduction to colloidal material, surface properties, origin of colloidal particles, preparation & characterization of colloidal particles. Applications of super hydrophilic & hydrophobic surfaces.

UNIT III SURFACTANT TECHNOLOGY 9

Introduction to surface active agents. Types of surfactants- Micelle-Emulsions-Micro emulsions – Gels - Applications of surface chemistry in biomedical industry -Ointment and absorption bases.

UNIT IV CORROSION AND SURFACE MODIFICATION 9

Basic principles of corrosion -Chemical and electrochemical corrosions-Factors influencing corrosion, Surface Modification - Classifications of surface coatings- Electroplating-Electrophoretic deposition- Advanced ceramic coating in automobile and biomedical industries

UNIT V BIOSENSORS 9

Basic principles of biosensor- Classification-characterization-properties. Application of Biosensors-Food Analysis, Bioprocess Control and Environmental Monitoring.

TOTAL HOURS : 45

OUTCOMES:

On completion of the course students will be able to

- get familiarized with surface and interfaces.
- analyze the characteristics of colloidal particles.
- describe the surfactant technology and its applications.
- apply the role of surface modification technology.
- develop and improve bio sensors.

TEXT BOOKS:

1. A.W. Adamson, A.P. Gast, Physical chemistry of surfaces, Wiley, 1997.
2. F. Scheller F. Schubert,Biosensors, Volume 11, 1st edition. eBook ISBN: 9780080875590, Imprint: Elsevier Science, Published Date: 21st November 1991.
3. McCafferty, E, Introduction to Corrosion Science, Springer-Verlag New York, eBook ISBN:978-1-4419-0455-3, Edition Number: 1, Year-2010

REFERENCE BOOKS:

1. H.-J. Butt, K. Graf, M. Kappl, Physics and Chemistry of Interfaces, Wiley-VCH, 2006.
2. Yoon, Jeong-Yeol, Introduction to Biosensors From Electric Circuits to Immunosensors, eBook ISBN, 978-3-319-27413-3, DOI:10.1007/978-3-319-27413-3.

OGE1701	HUMAN RIGHTS	L T P C
		3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons andDisabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOMES:

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delh

OGE1705 **PROGRAMMING LOGIC** **L T P C**
2 0 2 3

UNIT -1: INTRODUCTION TO C

Overview of C - Constants, Variables, and Data Types - Operators and Expressions - Managing Input and Output Operations

UNIT -2: CONTROL STRUCTURES

Branching – Looping – Arrays - Character Arrays and Strings

UNIT -3: FUNCTIONS

User-Defined Functions – Recursion - Structures and Unions – Pointers - File Management in C - The Preprocessor

UNIT -4: DATA STRUCTURES

Linked List – Stack – Queue – Trees – Binary Search Trees – Binary Heaps – Graphs – Asymptotic Notation - Time and Space Complexity - Divide and Conquer – Greedy Method.

UNIT -5: SORTING AND SEARCHING

Selection Sort – Bubble Sort – Quick Sort – Merge Sort – Heap Sort – Linear Search – Binary Search.

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

- Translate the algorithms to C Programs
- Implement conditional branching and iteration
- Decompose a problem into functions and synthesize a complete program using divide and conquer approach
- Understand and design how information is organized in storage of computer system.
- Provide Optimal Solutions for the given problem.

REFERENCES:

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Second Edition, PHI.
2. Byron Gottfried, "Programming in C", Second Edition, Schaum Outline Series.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2ndEdition, Pearson Education, 1997.

LABORATORY * 100 Problems to be solved

1. Simple computational problems using arithmetic expressions
2. Problems involving if-then-else structures
3. Iterative problems e.g., sum of series
4. Matrix problems, String operations
5. Programming for solving Numerical methods problems
6. Recursive functions
7. Pointers and structures
8. File operations
9. Stacks and Queues

10. Linked Lists
11. Trees
12. Sorting and Hashing
13. Graph search and traversal algorithms
14. Linear Search and Binary Search

OGE1705 ADVANCED PROGRAMMING LOGIC L T P C
2 0 2 3

UNIT -1: Algorithms

Strings: The Full Counting Sort - Highest Value Palindrome - Super Reduced String– Pangrams– Sherlock and Anagrams - Maximum Subarray Sum - Sorted Subsegments

UNIT -2: Greedy Algorithm

Reverse Shuffle Merge - The Coin Change Problem - Summing Pieces - Candles Counting - Play with words - Swap Permutation- Recursive Digit Sum.

UNIT -3: Trees and Graphs

Snakes and Ladders - Minimum Penalty Path - Toll Cost Digits - Tree: Huffman Decoding - Self Balancing Tree - Binary Search Tree : Lowest Common Ancestor - Swap Nodes.

UNIT -4: Advanced Programming

Longest Increasing Subsequence - Longest Common Subsequence – Knapsack - Matrix-chain multiplication - Nth Fibonacci Number - K-th Lexicographical Suffix - Palindrome Partitioning - Longest Arithmetic Progression - Word Wrap Problem - Mobile Numeric Keypad Problem-Case studies.

UNIT -5: Java APIs

Current Trends in IT-Eclipse IDE-HashSet, HashMap, ArrayList, LinkedList, TreeSet and TreeMap – Queue API – Stack API – JobStateReasons API.

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

- Decompose a problem into functions and synthesize a complete program using divide and conquer approach
- Understand and design how information is organized in storage of computer system.
- Provide Optimal Solutions for the given problem.

REFERENCES:

1. https://www.hackerrank.com/
2. Kathy Sierra and Bert Bates, “Sun Certified Programmer for Java 6”, Second Edition, McGraw Hill.
3. Paul Deitel and Harvey Deitel, “ Java How to Program: Early Objects”, 11th Edition, Pearson Education, 2018.

LABORATORY * 100 Problems to be solved