Course Code:16OET01	Course Title: AUTOMOTIVE INFOTRONICS	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Nil

Course Objectives

The course is intended to:

1. Describe about advanced driver assistance systems.
2. Explain about telematics
3. Explain about safety systems
4. Explain about comfort systems
5. Explain about security systems

Course Content **Hours**

UNIT I DRIVER ASSISTANCE SYSTEMS 9

Driver information, driver perception, driver convenience, driver monitoring, general vehicle control, longitudinal and lateral control, collision avoidance and vehicle monitoring.

UNIT II TELEMATICS 9

Global positioning system, geographical information systems, navigation system, architecture, automotive vision system and road recognition.

UNIT III SAFETY SYSTEMS 9

Active and passive safety, airbags, seat belt tightening system, forward collision warning systems, child lock, anti-lock braking systems, EBD, ESP, traction control system and lane departure warning system.

UNIT IV COMFORT SYSTEMS 9

Adaptive cruise control system, active suspension system, power steering, collapsible and tilt-able steering column and power windows, adaptive lighting system.

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UNIT V SECURITY SYSTEMS 9

Anti-theft technologies – mechanical, electromechanical and electronic immobilizers, alarm system, stolen vehicle tracking system, remote keyless entry, smart card system and number plate coding

Course Outcomes

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

CO1. Describe about advanced driver assistance systems to aid the vehicle control.
CO2. Explain about telematics used in automobiles
CO3. Explain about safety systems employed in automobile
CO4. Explain about vehicle comfort systems for passengers
CO5. Explain about security systems usage in vehicle

Text Books:

1. LjuboVlacic, Michel Parent and Fumio Harashima, "Intelligent Vehicle Technologies", Butterworth-Heinemann Publications, Oxford, 2001.
2. Robert Bosch, "Automotive Hand Book", SAE, 2000

References:

1. Ronald K Jurgen, "Navigation and Intelligent Transportation Systems – Progress in Technology", Automotive Electronics Series, SAE, USA, 1998.
2. William B R, "Understanding Automotive Electronics", Butter worth Heinemann Woburn, 1998.
3. Bechhold, "Understanding Automotive Electronics", SAE, 1998.
4. Allan W M B, "Automotive Computer Controlled Systems", Elsevier Butterworth-Heinemann, 2011 .

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Course Code:16OET02	Course Title: AUTOMOTIVE SENSORS	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Nil

Course Objectives

The course is intended to:

1. Explain the evolution of automotive sensors.
2. Describe about temperature sensors.
3. Describe about pressure sensors.
4. Describe about.speed and position sensors.
5. Describe about sensors mounted on the exhaust system.

Course Content **Hours**

UNIT 1 THE NEED FOR AUTOMOTIVE SENSORS 9

Health and Environmental Impacts of automotive pollution - Schematic and working principle of Multi Point Fuel Injection (MPFI) and Common Rail Direct Injection (CRDi) engines - Bharat Stage Emission Standards (BSES) - Sensor types: Active and Passive - Sensor Protection: High voltage, Short circuit and Reverse polarity - Sensor power supply and Ratio-metric output

UNIT II TEMPERATURE SENSORS 9

Inlet air temperature sensor, Coolant temperature sensor, Engine Oil temperature sensor, Exhaust gas temperature sensor - Application, construction and working principle.

UNIT III PRESSURE SENSORS 9

Manifold absolute pressure (MAP) sensor, TMAP sensor, BAP sensor, Fuel tank pressure sensor, Oil pressure sensor, Common Rail Pressure sensors, Tyre pressure monitoring sensor (TPMS) – Application, construction and working principle.

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UNIT IV SPEED AND POSITION SENSORS 9

Engine rpm sensor, Crankshaft position sensor, Camshaft position sensor, Throttle position sensor, Pedal position sensor, Steering position sensor – Application, construction and working principle.

UNIT V SENSORS MOUNTED ON THE EXHAUST SYSTEM 9

O_2 sensor, NOx sensor, Ammonia sensor, Differential pressure sensor, Soot sensor - Application, construction and working principle.

Course Outcomes

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

CO1. Explain the evolution of automotive sensors and their application in automobiles.
CO2. Describe about temperature sensors, their construction, working principle and performance characteristics.
CO3. Describe about pressure sensors, their construction, working principle and performance characteristics.
CO4. Describe about speed and position sensors, their construction, working principle and performance characteristics.
CO5. Describe about sensors for after treatment with their construction, working principle and performance characteristics.

Text Books:

1. John Turner, "Automotive Sensors", Momentum Press LLC, New Jersey, 2009.
2. Edward Ramsden, "Hall-Effect Sensors: Theory and Application", Newnes Publications, 2006.
3. "Automotive Sensors", Robert Bosch GmbH, 2002

References:

1. "Gasoline-Engine Management", Robert Bosch GmbH, 2006.
2. "Diesel -Engine Management", Robert Bosch GmbH, 2005
3. "Bosch Automotive Handbook", SAE International, 10th Edition, 2010

Learning Resources

- MCET-TUV Automotive Training Center
- MCET-BOSCH Joint Certification Center

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Course Code: 16OET03	Course Title: ELECTRONICS IN AUTOMOBILES	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites:

The student should have undergone the course(s):

- Nil

Course Objectives

The course is intended to:

1. Illustrate the layout of automobile systems
2. Explain about electronic gasoline control system
3. Explain about electronic diesel control system
4. Explain about electronic suspension and steering system
5. Explain about brake and stability control systems

Course Content **Hours**

UNIT I AUTOMOBILE SYSTEM LAYOUT 9

SI and CI engine, working principle. Engine emissions and standards. Suspension system layout. Steering system layout. Brake system layout.

UNIT II ELECTRONIC GASOLINE CONTROL 9

Layout of SI engine management systems, Multi-Point Fuel Injection (MPFI), Gasoline Direct Injection (GDI) – electric fuel pump, piezo-injector, pencil coil, electronic throttle control, electronic ignition systems, spark timing control.

UNIT III ELECTRONIC DIESEL CONTROL 9

Layout of CI engine management systems , CRDI, engine control units in CAN databus, metering regulation, injection regulation, Exhaust gas recirculation control, charge pressure control, pre glow system, idling speed control, cruise control.

UNIT IV ELECTRONIC SUSPENSION AND STEERING SYSTEM 9

Electronic suspension system, components – height sensor, vehicle speed sensors, acceleration sensors, steering wheel rotation sensor, electric power steering – working. Non-contact torque sensor – principle of operation.

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UNIT V ABS, TCS AND ESP SYSTEMS 9

Anti-lock Braking System (ABS). need, layout and working, wheel speed sensor, pressure modulator valve. Traction Control System (TCS), layout and working, wheel speed control – operation modes. Electronic Stability Control (ESP), need, layout and working.

Course Outcomes

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

CO1. Illustrate the layout of automobile systems to identify the location of sensors.

CO2. Explain the electronic gasoline control system to control emission to meet the emission standards.

CO3. Explain the electronic diesel control system to control emission to meet the emission standards.

CO4. Explain the components of electronic suspension and steering and their working principle.

CO5. Explain the layout and working of brake and stability control systems.

Text Books:

1. Eric Chowanietz "Automobile Electronics" SAE Publications, 2014
2. William B Ribbens "Understanding Automotive Electronics", SAE Publications, 2008

References:

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

Learning Resources

- MCET-TUV Automotive Training Center
- MCET-BOSCH Joint Certification Center

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Course Code: 16OET04	Course Title: MANUFACTURING OF AUTOMOTIVE ELECTRICAL AND ELECTRONICS PARTS	
Core / Elective: Elective	L: T : P: C	3 :0: 0 : 3
Type : Theory	Total Contact hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Nil

Course Objectives

The course is intended to:

1. Explain the characteristics and effects of components on circuit board.
2. Explain the parameters and methods involved in integration of electrical and electronics parts
3. Explain the steps involved in fabrication of Electrical parts
4. Explain the steps involved in fabrication of Electronic parts
5. Explain the process involved in manufacturing of lighting system

Course Content **Hours**

UNIT I BASICS OF ELECTRICAL AND ELECTRONICS 6

Introduction of Resistor, capacitor, inductor and characteristics under AC & DC, Power dissipation, Fuse and fuse selection, Electromagnetic compatibility (EMC), Interference.

UNIT II INTEGRATION OF ELECTRICAL & ELECTRONIC PARTS ON VEHICLE 10

Overview of ADV, Prod Quality Planning /New Prod Develop, Vehicle Integration-Mounting methods, Routing methods, Fastening, Clearance/Interference fit.

UNIT III MANUFACTURING OF AUTOMOTIVE ELECTRICAL PARTS 10

Process flow, process specifications and Inspection methodologies for Starter motor, Relay, Horn, Switches, Magneto and Wiring Harness.

UNIT IV MANUFACTURING OF AUTOMOTIVE ELECTRONIC PARTS 10

Process flow, Manufacture of PCB, PCB assembly and Testing, Electronic Packaging.

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UNIT V MANUFACTURING OF AUTOMOTIVE LIGHTING SYSTEM 9

Basic principles and working of lighting system, Process flow and process specifications for automotive lighting system

Course Outcomes

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

CO1: Explain the characteristics and effects of components on circuit board that are used in a motorcycle

CO2: Explain the parameters and methods involved in integration of electrical and electronics parts in a motorcycle

CO3: Explain the steps involved in fabrication of Electrical parts used in a motorcycle

CO4: Explain the steps involved in fabrication of Electronic parts in a motorcycle

CO5: Explain the process involved in manufacturing of lighting system used in a motorcycle

Text Books:

1. Raymond H. Clark, "Handbook of Printed Circuit Manufacturing" Springer 1st edition, 1985.
2. H. Richard Stillwell, "Electronic Product Design for Automated Manufacturing" CRC Press, 1st edition, 1988.

Reference Books:

1. V.K. Mehta Rohit Mehta, "Principles of Electrical Engineering and Electronics" 3rd edition, S Chand Publishers, 2014.

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OPEN ELECTIVES

Course Code : 16OET08	Course title : SAFETY ENGINEERING	
Core/Elective: Elective	L: T : P : C	3 : 0 : 0 : 3
Type : Theory	Total Contact hours:	45

COURSE OBJECTIVES

The course is intended to:

1. Explain basic concepts in safety, safety policy and its techniques
2. Explain basic concepts in Health and hygiene in the occupational environment
3. Describefire explosion control techniques in various industries
4. Explain safety standards in construction industry
5. Describe the safety materials to be used in the field of work

UNIT I - INTRODUCTION TO CONCEPTS 9

Concept of safety - Evolution of modern safety concept- Safety policy - Safety Organization - line and staff - functions for safety- Safety Committee- budgeting for safety. Techniques- Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT II - OCCUPATIONAL HEALTH AND HYGIENE 9

Physical hazards - Noise, noise exposure regulation, occupational damage, risk factors, and permissible exposure limit. Ionizing radiation, types, effects, monitoring instruments, control programs, control measures. Chemical hazards - Recognition of chemical hazards- dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, Methods of Control. Concept and spectrum of health - functional units and activities of occupational health services, pre employment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases.

UNIT III - FIRE ENGINEERING AND EXPLOSION CONTROL 9

Fire chemistry – Dynamics of fire behavior – Fire properties of solid, liquid and gas – Fire spread – Toxicity of products of combustion. Building evaluation for fire safety – Fire load – Fire resistance materials and fire testing –Structural Fire protection – Exits and egress. Statutory Rules and Techniques of fire fighting - Indian Explosive acts and rules – Techniques of fire fighting and demonstration.

UNIT IV - SAFETY IN CONSTRUCTION 9

General safety consideration – analyzing construction jobs for safety – Contract document –Safety certificate for statutory authorities for old building and construction. Safety in Erection and closing operation - Construction materials –Specifications – suitability – Limitations. Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls- Critical factors for failure-Regular Inspection and monitoring.

UNIT V - SAFETY IN MATERIAL HANDLING 9

General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears. Selection, operation and maintenance of Industrial Trucks – Mobile Cranes – Tower crane –Checklist - Competent persons.

COURSE OUTCOMES

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

CO 1. Explain basic concepts in safety, safety policy and its techniques

CO 2. Explain basic concepts in Health and hygiene in the occupational environment

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CO 3. Describefire explosion control techniques in various industries
CO 4. Explain safety standards in construction industry
CO 5. Describe the safety materials to be used in the field of work

TEXT BOOKS:

1. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997
2. Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 1982

REFERENCE BOOKS:

1. Handbook of Occupational Health and Safety, NSC Chicago, 1982
2. James, D., Fire Prevention Handbook, Butterworths, London, 1986.
3. Gupta R.S., Handbook of Fire Technology, Orient Longman, Bombay, 1997.
4. Fulman, J.B., Construction Safety, Security, and Loss Prevention, John Wiley and Sons,1979
5. Alexandrov, M.P., Material Handling Equipment, Mir Publishers, Moscow, 1981
6. Rudenko N., Material Handling Equipments, Mir Publishers, Moscow, 1981.

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Course Code : 16OET09	Course title : ENVIRONMENTAL IMPACT ASSESSMENT	
Core/Elective: Elective	L: T : P : C	3 : 0 : 0 : 3
Type : Theory	Total Contact hours:	45

COURSE OBJECTIVES

The course is intended to:

1. Describe the objectives, capability, and limitations of EIA.
2. Elucidate the methods of EIA with case studies.
3. Apply the knowledge of the impact of infrastructure projects on air quality, water quality, vegetation and wildlife.
4. Explain the environmental management plan.
5. Describe the EIA for various infrastructural projects.

UNIT I - INTRODUCTION 9

Impact of development projects under Civil Engineering on environment – Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA –EIA notifications –EIA consultants.

UNIT II - METHODOLOGIES 9

Methods of EIA- strength, weakness and applicability of EIA– Appropriate methodology – Process Screening – Baseline studies-Mitigations-Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives.

UNIT III - AIR QUALITY, NOISE, ENERGY, WATER QUALITY, VEGETATION AND WILDLIFE IMPACT 9

Background - typical considerations and factors, Air quality impact of industry, transport systems, human settlements. Effects of noise on people, noise scales and rating methods. estimating transportation -noise impact. Energy Impact considerations, data sources, energy conservation data. Water quality criteria and standards, waste quality impacts by development projects – Vegetation impact -wild life impact - impact on flora and fauna-Socio Economic impact-Rapid EIA-Post Environmental Audit.

UNIT IV - ENVIRONMENTAL MANAGEMENT PLAN 9

Plan for mitigation of adverse impact on environment – options for mitigation of impact on water, air & land, flora and fauna; addressing the issues related to Project Affected People – ISO 14000

UNIT V - CASE STUDIES 9

EIA for infrastructure projects – Highways and Bridges – Stadium – Railways – Dams – Multi-storey Buildings – Water Supply and Drainage Projects – Power plant.

COURSE OUTCOMES

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

CO.1 Describe the objectives, capability, and limitations of EIA.
CO.2 Elucidate the methods of EIA with case studies.
CO.3 Apply the knowledge of the impact of infrastructure projects on air quality, water quality, vegetation and wildlife.
CO.4 Explain the environmental management plan.
CO.5 Describe the EIA for various infrastructural projects.

TEXT BOOKS:

1. Canter, R.L., "Environmental Impact Assessment", McGraw-Hill Inc., New Delhi, 1996.

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2. Shukla. S.K. and Srivastava. P.R.,"Concepts in Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.
3. Anjanayulu,Y., "Environmental Impact Assessment Methodologies", B.S Publications, Hyderabad,2011.

REFERENCE BOOKS:

1. John G. Rau and David C Hooten (Ed)., "Environmental Impact Analysis Handbook", McGraw-Hill Book Company, 1990.
2. "Environmental Assessment Source book", Vol. I, II & III. The World Bank, Washington, D.C.,1991.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I & II", Blackwell Science,1999.

WEB REFERENCES:

1. http://envfor.nic.in/division/introduction-8
2. http://nptel.ac.in/courses/120108004
3. http://environmentclearance.nic.in/writereaddata/EIA%20Notifications

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OPEN ELECTIVES

Course Code: 16OET19	Course Title: HUMAN COMPUTER INTERFACE DESIGN	
Open Elective	L: T: P: C	3: 0: 0: 3
Type: Theory	Total Contact Hours:	45

Course Objectives

The course is intended to:

1. Describe the fundamental HCI concepts.
2. Apply the various modes of user interactions.
3. Design the user interface prototype.
4. Apply the standards and principles of User Interface.
5. Implement the universal design principles.

Unit I – HCI FOUNDATIONS 9

Human: Input - Output Channel - Human Memory - Thinking: Reasoning and Problem Solving - Emotion - Psychology - Computer: Text Entry devices-Display Devices-Pointing Devices-Memory-Processing and Networks.

Unit II – INTERACTION AND PARADIGMS 9

Interaction : Modes of Interaction – Frameworks and HCI – Ergonomics – Interaction Styles – Windows Icon Pointer and Menus Interfaces – Interactivity – Context – Paradigms

Unit III – DESIGN PROCESS 9

Process of Design - User Focus – Scenarios – Navigation Design – Screen design and Layout – Prototyping – HCI Software Life Cycle – Usability Engineering – Iterative Design and Prototyping – Design Rationale.

Unit IV – IMPLEMENTATION 9

Principles – Standards – Guidelines – Golden Rules – Patterns – Implementation elements – Programming – Toolkits – UI Management Systems – Evaluation Techniques

Unit V – UNIVERSAL DESIGN AND USER SUPPORT 9

Universal design Principles – Multimodal Interaction – Designing for Diversity – Requirements and approaches for User Support – Help Systems – Designing user Support systems.

Course Outcomes

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

1. Describe the fundamental HCI concepts for interface design.
2. Apply the various modes of user interactions suitable for the given context.
3. Design the user interface prototype with appropriate life cycle model.

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4. Apply the standards and principles for effective implementation of user interface.
5. Implement the universal design principles to support effective user experience.

Text Book:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", Third Edition, Perason Education, 2004

Reference Books:

1. Gerard Jounghyun Kim, "Human Computer Interaction: Fundamentals and Practice", CRC Press, 2015.
2. Julie A.Jacko, "The Human Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications", Third Edition, CRC Press, 2012.

Web References:

1. NPTEL Videos: Human Computer Interaction. URL: http://nptel.ac.in/courses/106103115/
2. MIT OpenCourseWare: User Interface Design and Implementation. URL: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-831-user-interface-design-and-implementation-spring-2011/

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Course Code: 16OET20	Course Title: COMPUTER FORENSICS	
Open Elective	L: T: P: C	3: 0: 0: 3
Type: Theory	Total Contact Hours:	45

Course Objectives

The course is intended to:

1. Describe the cyber security policy and its evolution.
2. Summarize the scope and laws of computer forensics.
3. Explain the process of acquiring and documenting computer forensic evidence.
4. Describe the steps involved in investigating network forensics.
5. Comprehend the steps involved in investigating mobile forensics.

Unit I - CYBER SECURITY 9

Cyber Security – Cyber Security policy – Domain of Cyber Security Policy: Laws and Regulations, Enterprise Policy, Technology Operations, Technology Configuration - Strategy Versus Policy – Cyber Security Evolution: Productivity, Internet, E-commerce, Counter Measures, Challenges.

Unit II - SCOPE AND LAWS OF COMPUTER FORENSICS 9

Scope of computer forensics: Introduction, Types of Evidence, Investigator skills, Importance, History of Computer Forensics, Law Enforcement Training – Operating systems and file systems.

Unit III - ACQUIRING EVIDENCE AND DOCUMENTATION 9

Lab Requirements - Private Sector Computer Forensics Laboratories - Computer Forensics Laboratory Requirements - Extracting Evidence from a Device - Documenting the Investigation.

Unit IV - NETWORK FORENSICS 9

Tools - Networking Devices - Understanding the OSI Model - Advanced Persistent Threats - Investigating a Network Attack.

Unit V - MOBILE FORENSICS 9

Cellular Network - Handset Specifications - Mobile Operating Systems - Standard Operating Procedures for Handling Handset Evidence - Handset Forensics - Case studies.

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Course Outcomes

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

1. Describe the cybersecurity policy and its evolution for the purpose of computer forensics.
2. Summarize the scope and laws of computer forensics for cyber security professionals.
3. Explain the process of acquiring and documenting computer forensic evidence for investigation.
4. Describe the steps involved in investigating network forensics for attacks.
5. Comprehend the steps involved in investigating mobile forensics with case studies.

Text Book:

1. Darren R. Hayes, "A Practical Guide to Computer Forensics Investigations", First Edition, Pearson, 2014.

Reference Books:

1. Bill Nelson, Amelia Phillips, Christopher Steuart, "Computer Forensics and Investigations", Third Edition, Cengage learning, 2010.
2. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics", Second Edition, Tata McGraw -Hill, 2006.

Web References:

1. http://dst.gov.in/basic-research-cyber-security
2. https://www.sans.org/reading-room/whitepapers/incident/developing-computer-forensics-team-628
3. https://www.cybrary.it/cyber-security/

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Course Code: 16OET26	Course Title: AUGMENTED REALITY AND VIRTUAL REALITY	
Open Elective	L: T: P: C	3: 0: 0: 3
Type: Theory	Total Contact Hours:	45

Course Objectives

The course is intended to:

1. Describe the fundamentals of XR.
2. Explain the basics of Augmented Reality.
3. Outline the Virtual Reality Architecture and Modeling.
4. Apply the design principles of Augmented Reality apps.
5. Develop Virtual Reality applications.

Unit I - XR OVERVIEW 9

XR Terms: VR, AR, and MR Foundations; Industrial applicability of XR; Overview on Supported Hardware and Software, Applications: Engineering, Architecture, Education, Medicine, Entertainment, Science and Training.

Unit II - AR PRINCIPLES 9

AR Definition, Displays: Multimodal Displays, Spatial Display Model, Visual Displays, Tracking, Calibration and Registration - Mobile Sensors - Computer Vision for AR.

Unit III - VR IO, MODELING AND APPLICATIONS 9

VR Definition, Input Devices: Trackers, Navigation and Gesture Interfaces, Output Devices: Graphics, Three Dimensional Sound and Haptic Displays, Computer Architecture for VR, Modeling, Traditional Applications.

Unit IV - AR APPLICATION DEVELOPMENT 9

Mobile Application for Image Tracking, Image Dataset Generation, Setting up AR Environment, Animation and transformation (Scale, Move, Rotate, Transform), Build Generation for iOS and Android.

Unit V - VR APPLICATION DEVELOPMENT 9

Virtual Environment Placement, SDK import and setup, 3D walkthrough, Object Grabbing, Transformation, Hand Avatar manipulation, World space menu creation.

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Course Outcomes

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

1. Describe the fundamentals of XR with example applications.
2. Explain the basics of augmented reality with real time examples.
3. Outline the Virtual Reality Architecture and Modeling for real time applications.
4. Apply the design principles and practices of augmented reality apps for Industrial sectors.
5. Develop the virtual reality applications by choosing appropriate tools.

Text Books:

1. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", John Wiley & Sons, Inc., Second Edition, 2008.
2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", Pearson Education (US), Addison-Wesley Educational Publishers Inc, First Edition, 2016.

Reference Books:

1. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technology Applications, and Human Factors for AR and VR", Addison-Wesley Professional, First Edition, 2016.
2. Robert Scoble, Shel Israel, "The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything" , Patrick Brewster Press, First edition, 2016.
3. Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile", O'Reilly Media, First edition, 2015.

Web References:

1. Build Virtual Worlds
   URL:https://developers.google.com/vr/
2. Quick Start for unreal
   URL:https://developers.google.com/ar/develop/unreal/quickstart
3. Quick Start for Unity Android
   URL:https://developers.google.com/ar/develop/unity/quickstart-android.
4. Unity User Manual
   URL:https://docs.unity3d.com/Manual/UnityManual.html

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Course Code:16OET10	Course Title:DATA SCIENCE USING HADOOP WITH R	
Elective	L:T:P:C	3: 0 : 0 :3
Type:Theory	Total Contact hours:	45

Prerequisites: The student should have undergone the course(s):

- 16GET14 - C-Programming
- 16CST35 - Data Structures and OOPS with C++
- 16MAT42 - Probability Theory and Statistics

Course Objectives:

The course is intended to:

1. Describe the significance of Big Data.
2. Solve the basic Analysis problem.
3. Explain the YARN architecture, configuration and containers.
4. Use suitable data types forbasic operations.
5. Choose an appropriate plot for visualizing the data.

UNIT I -INTRODUCTION TO BIG DATA 9

Data science process – roles, stages in data science project, What is Big Data-types of data-elements of big data-big data analytics. Exploring the big data stack-big data applications.

UNIT II -HADOOP ECO SYSTEM 9

Hadoop ecosystem-Hadoop Distributed File System-MapReduce framework techniques to optimize MapReduce jobs-uses of MapReduce.

UNIT III -HADOOP YARN ARCHITECTURE 9

YARN Architecture-working of YARN-YARN schedulers-backward compatibility with YARN-YARN configurations-YARN commands-YARN containers.

UNIT IV-INTRODUCTION TO R 9

Basic features of R-data types in R-reading data sets-reading and combining numeric, text-reading multiple data values from large values-reading data from R Studio-exporting data from R.

UNIT V -MANIPULATING AND PROCESSING DATA IN R 9

Creating data subset-merging datasets in R-sorting data-melting-casting-matrices-data frames-functions-arguments in functions-built-in functions in R-plots-RHadoop-integration of R and Hadooptext mining in RHadoop.

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Course Outcomes:

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

CO1. Describe the significance of Big Data.
CO2. Solve the basic Analysis problem using Map and reduce
CO3. Explain the YARN architecture, configuration and containers
CO4. Use suitable data types forbasic operations on data
CO5. Choose an appropriate plot for visualizing the data.

Text Books:

1. Black Book, "BIG DATA", DT Editorial Services, Dream tech press, Edition:2016.
2. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, USA, 2011.

Reference Books:

1. Jimmy Lin and Chris Dyer, "Data Intensive Text Processing using Map Reduce", Morgan and Claypool Publishers, USA, 2010.
2. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.
3. ArvindSathi, "Big Data Analytics: Disruptive Technologies for changing the game(paperback)", Mc Press, 2012.
4. Dirk deRoos, "HadoopFor Dummies", John Wiley & Sons, 2014.

Web References:

1. https://www.datascience.com/resources#.learn-data-science
2. http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction
3. http://lintool.github.io/MapReduceAlgorithms/ed1n.html
4. https://www.tutorialspoint.com/r/r_overview.htm

BoS Chairman

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HOD, Electronics and Communication Engineering
Dr. Mahalingam College of Engineering and Technology
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Course Code:16OET11	Course Title:ARTIFICIAL INTELLIGENCE	
Elective	L:T:P:C	3: 0 : 0 :3
Type:Theory	Total Contact hours:	45

Prerequisites: The student should have undergone the course(s):

- 16CST35 - Data Structures and OOPS with C++

Course Objectives:

The course is intended to:

1. Identify a suitable Artificial Intelligence methods
2. Explain the knowledge representation
3. Explain the various reasoning techniques
4. Interpret the concepts of planning and machine learning
5. Explain the concepts of typical expert systems and its architectures

UNIT I -INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9

Introduction to AI - Problem formulation, Problem Definition - Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics, – Heuristic search - Depth first and Breath first, Generate and test, Hill Climbing, Best first search, Search in Game playing.

UNIT II -REPRESENTATION OF KNOWLEDGE 9

Knowledge representation issues: representation and mapping, approaches, issues Knowledge representation using Predicate logic- Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using Rules – Logic programming, Forward vs Backward knowledge, Matching.

UNIT III -REASONING 9

Introduction to Non-monotonic reasoning –Logics – Implementation issues – Implementation: depth-first search – Statistical reasoning – Probability and Bayes theorem – Bayesian networks – Dempster –Shafer theory – Fuzzy logic

UNIT IV-KNOWLEDGE ACQUISITION AND MACHINE LEARNING 9

Knowledge Acquisition process – Meta knowledge - Components of planning system – Understanding – Learning – Rote learning – Explanation based Learning – Inductive Learning - Natural language processing.

UNIT V -EXPERT SYSTEMS 9

Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells. AI for robotics.

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Course Outcomes:

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

CO1:Identify a suitable Artificial Intelligence methods for solving the given problems.
CO2:Explain the knowledge representation using various logics and rule based systems
CO3:Explain the knowledge using various reasoning techniques
CO4:Interpret the concepts of planning and machine learning
CO5:Explain the concepts of typical expert systems and its architectures

Text Books:

1. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill- 2008.
2. R.B.Mishra, "Artificial Intelligence" PHI learning private ltd,2011.

Reference Books:

1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007
3. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.
4. N.P.Padhy, "Artificial Intelligence and Intelligent systems" Oxford University press, Fourth Edition, 2008

Web References:

1. http://nptel.ac.in/courses/106105077/
2. https://in.udacity.com/course/intro-to-artificial-intelligence--cs271
3. https://www.tutorialspoint.com/artificial_intelligence/index.htm

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Course Code:16OET12	Course Title:SOFT COMPUTING	
Elective	L:T:P:C	3: 0 : 0 :3
Type:Theory	Total Contact hours:	45

Prerequisites: The student should have undergone the course(s):

- 16CST35 - Data Structures and OOPS with C++

Course Objectives:

The course is intended to:

1. Explain the basics of Soft computing and Fuzzy theory.
2. Apply the fuzzy theory for problem solving.
3. Explain the supervised learning of neural networks.
4. Explain the concepts of fuzzy and neural networks.
5. Optimize a problem using Genetic Algorithm.

UNIT I -INTRODUCTION TO SOFT COMPUTING 9

Introduction to Soft computing – Soft computing techniques – Types of Problems: Classification, Functional Approximation, Optimization - Modelling the problems. Introduction to classical set and fuzzy set- Classical relation and fuzzy relation – Fuzzy arithmetic - Fuzzy measures

UNIT II -APPLICATION OF FUZZY SETS 9

Fuzzy Membership function – Fuzzy Rule base and reasoning – Fuzzy Inference System – Defuzzification - Fuzzy Decision making – Fuzzy based clustering

UNIT III -ARTIFICIAL NEURAL NETWORKS 9

Introduction to Artificial Neural Networks (ANN) – Models and Terminologies of ANN – Hebb Network –Learning methods: Supervised and unsupervised learning. Supervised learning networks: Perceptrons – Adaline – Back propagation network – Radial basis function network.

UNIT IV-UNSUPERVISED LEARNING NETWORKS AND NEURO-FUZZY SYSTEMS 9

Unsupervised Learning Networks: Kohonen self-organizing network – Learning Vector quantization – Counter Propagation networks. Introduction to hybrid systems – Architecture of Adaptive Neuro Fuzzy Inference System (ANFIS) – Hybrid learning algorithm

UNIT V -OPTIMIZATION 9

Introduction to optimization – principles of optimization – Duality principle – Classification of optimization problems – Traditional optimization methods and its drawbacks – Evolutionary concepts in optimization: Genetic Algorithm (GA) – Simple GA – Binary coded GA – Limitations of Binary coded GA

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Course Outcomes:

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

CO1: Explain the basics of soft computing and Fuzzy theory
CO2: Apply the fuzzy theory for problem solving
CO3: Explain the supervised learning of neural networks
CO4: Summarize the concepts of fuzzy and neural networks
CO5: Optimize a problem using Genetic Algorithm

Text Books:

1. Sivanandam.S.N, Deepa.S.N, "Principles of soft computing",2nd Edition, Wiley India Pvt Limited, 2011.
2. Jyh - Shing Roger Jang, Cheun Tsai Sun, Eiji - Mizutani, "Neuro fuzzy and Soft computing", Prentice Hall, 1997.

Reference Books:

1. Dilip Kumar Prathiar, "Soft Computing" Narosa Publishing House Pvt Ltd, 2008
2. Anupam - shukla, RituTiwari, Rahul Kala, "Real life applications of Soft computing", CRC press, 2010.
3. Aliev,R.A, Aliev,R.R, "Soft Computing and its Application", World ScientificPublishing Co. Pvt. Ltd., 2001.
4. Mehrotra.K, Mohan.C.K, Ranka.S, "Elements of Artificial Neural Networks", The MIT Press, 2nd Edition, 2000.
5. Ronald R.Yager, Lofti - Zadeh, "An Introduction to fuzzy logic applications in intelligentSystems", Kluwer Academic, 1992.

Web References:

1. http://www.myreaders.info/html/soft_computing.html
2. https://www.tutorialspoint.com/artificial_intelligence/
3. http://www.soft-computing.de/def.html
4. http://nptel.ac.in/courses/106106046/41

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Course Code:16OET13	Course Title: MACHINE VISION SYSTEM	
Elective	L:T:P:C	3: 0 : 0 :3
Type: Theory	Total Contact hours:	45

Prerequisites: The student should have undergone the course(s):

- 16ECE16 - Digital Image Processing

Course Objectives:

The course is intended to:

1. Describe the fundamental concepts in machine vision systems
2. Explain the concepts of image acquisition
3. Practice the algorithms for machine vision
4. Illustrate the pattern recognition algorithms
5. Apply the machine vision algorithms for real time applications

UNIT I - INTRODUCTION TO MACHINE VISION 9

The nature of vision - tasks for a vision system – The image: representations and properties - mathematical and physical background - Data structures for image analysis - Basic Image Filtering Operations

UNIT II - IMAGE ACQUISITION AND CONVERSION 9

Illumination - Electromagnetic Radiation - Types of Light Sources - Interaction of Light and Matter - Lenses - Pinhole Cameras - Gaussian Optics – Depth of Field – Tele centric Lenses - Lens Aberrations - Cameras : CCD Sensors CMOS Sensors - Color Cameras - Sensor Sizes - Camera-Computer Interfaces - Image Acquisition Modes - Camera Calibration - Camera Models for Area Scan Cameras - Camera Model for Line Scan Cameras - Calibration Process - Accuracy of the Camera Parameters.

UNIT III - MACHINE VISION ALGORITHMS 9

Image Enhancement - Gray Value Transformations - Image Smoothing - Thresholding - Extraction of Connected Components - Feature Extraction - Morphology - Edge Extraction – Image Segmentation - Segmentation and Fitting of Geometric Primitives

UNIT IV - PATTERN RECOGNITION 9

Template Matching Gray-Value-Based Template Matching - Template Matching with Rotations and Scalings - Optical Character Recognition- Classifiers: parametric classifiers – non parametric classifiers - nearest neighbor- neural networks.

UNIT V - MACHINE VISION APPLICATIONS 9

Reading of Serial Numbers - Inspection of Saw Blades - Inspection of Ball Grid Arrays (BGA) - Surface Inspection - Inspection of Punched Sheets - Pose Verification of Resistors.

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Course Outcomes:

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

CO1: Describe the fundamental concepts in machine vision systems by studying the fundamental concepts of image representation and its properties
CO2: Explain the concepts of image acquisition using various cameras and its interfacing techniques
CO3: Practice the algorithms for machine vision using image segmentation, Edge extraction and morphological operations
CO4: Illustrate the pattern recognition algorithms like template matching and classifiers
CO5: Apply the machine vision algorithms for real time applications for inspection , reading and measuring applications

Text Books:

1. Carsten Steger, Markus Ulrich, and Christian Wiedemann "Machine Vision Algorithms and Applications" Wiley-VCH; 1st edition (2007).
2. E.R.Davies, "Machine Vision: Theory, Algorithms, Practicalities" Elsevier, Technology& Engineering , (2004).
3. Alexander Hornberg, "Handbook of Machine Vision" John Wiley & Sons, (2007).

Reference Books:

1. Richard O.Duda, Peter E. Hurt, Pattern Classification and Scene Analysis Publisher, 1973
2. Rafael C. Gonzaies, Richard E. Woods, Digital Image processing publisher, 1992.
3.Nellazuech, 'Understanding & applying machine vision Marceldekker Inc.2000.
4.E. R. DAVIES, Computer and Machine Vision: Theory, Algorithms, Practicalities, Academic Press(2012).
5. Harley R. Myler, "Fundamentals of Machine Vision", SPIE Press, (1999).

Web References:

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. https://nptel.ac.in/courses/122101003/2
3. https://nptel.ac.in/syllabus/111104092/

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Course Code:16OET27	Course Title: IN VEHICLE NETWORKING	
Elective	**L:T:P:C**	**3: 0 : 0 :3**
Type: **Theory**	Total Contact hours:	**45**

Prerequisites: The student should have undergone the course(s):

- Nil

Course Objectives:
The course is intended to:

1. Explain the fundamental concepts and architecture of in-vehicle networking
2. Develop the in-vehicle networking using Controlled Area Network
3. Demonstrate the Flexray protocol for in-vehicle networking
4. Model the Local Interconnect Network (LIN) for vehicular networking
5. Design the model of Media Oriented System Transport in-vehicle networking

UNIT I - INTRODUCTION TO IN-VEHICLE NETWORKING **9**

Introduction to Computer Networks - Network Topologies - Types of Networks: Local Area Networks, Wide Area Networks - Vehicle network Architecture - Vehicle network.

UNIT II - CONTROL AREA NETWORK **9**

Layered Architecture - ISO 11898 Architecture - CAN Physical Layer- CAN transceiver – CAN working example.

UNIT III - FLEX RAY **9**

Flex ray Architecture - topologies: Multi-drop Bus, star and hybrid – node operation – frames and signals – Applications.

UNIT IV -LOCAL INTERCONNECT NETWORK **9**

Introduction: Transmit & receive data through LIN network- The power management in LIN network - LIN Versus CAN.

UNIT V - MEDIA ORIENTED SYSTEM TRANSPORT **9**

MOST in ISO-OSI reference model – Types – Topology – MOST physical layer – Frames and signals – Functioning and synchronization.

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Course Outcomes:

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

CO1: Explain the fundamental concepts and architecture of in-vehicle networking.
CO2: Develop the in-vehicle networking using Controlled Area Network.
CO3: Demonstrate the Flexray protocol for in-vehicle networking .
CO4: Model the Local Interconnect Network (LIN) for vehicular networking.
CO5: Design the model of Media Oriented System Transport in-vehicle networking .

Text Books:

1.Kirsten Matheus, Thomas Königseder., Automotive Ethernet, Cambridge University Press, UK, 1st Edition 2015.
2.Dominique Paret.Multiplexed Networks for Embedded Systems: CAN, LIN, FlexRay, Safe-by-Wire, John Wiley & Sons Ltd. 1st Edition 2007.
3.ChristophSommer, Falko Dressler., Vehicular Networking, Cambridge University Press, UK, 1st Edition 2015.

Reference Books:

1. Marc Emmelmann, Bernd Bochow, Christopher Kellum.,Vehicular Networking: Automotive Applications and Beyond, John Wiley & Sons Ltd, 1st Edition 2010.
2. Hannes Hartenstein, Kenneth Laberteaux.,VANET: Vehicular Applications and Inter- Networking Technologies, John Wiley & Sons Ltd, 1st Edition 2010.
3. Stephan Olariu, Michele C. Weigle, Vehicular Networks: From Theory to Practice, CRC Press, USA,1st Edition 2009.

Web References:

1.https://www.elprocus.com/controller-area-network-can/
2. https://www.embitel.com/product-engineering-2/automotive/in-vehicle-networking
3.https://www.globaledgesoft.com/blog-posts/in-vehicle-networking-at-a-glance/

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OPEN ELECTIVE

T14

Course Code: 16OE~~812~~	Course Title: ELECTRIC AND HYBRID VEHICLES
Core/Elective: Open Elective	Credits (L:T:P:C:M) – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours: 45

Pre-requisites:

- 16EET33- DC Machines and Transformers
- 16EET41 -Synchronous and Induction Machines

Course Objectives

The course is intended to:

1. Enumerate the need and performances of Electric vehicles.
2. Identify the types of Architectures in Electric & Hybrid Vehicles.
3. Discuss the electric propulsion system and motor controlling techniques.
4. Describe the energy storage system and generators in electric hybrid vehicle.
5. Explain the construction and working of fuel cells & solar cars.

UNIT I ELECTRIC VEHICLES 9

Layout of an Electric Vehicle, performance of electric vehicles – traction motor characteristics, tractive effort,
transmission requirements, vehicle performance, energy consumption, advantage and limitations,specifications,system components, electronic control system.

UNIT II HYBRID VEHICLES 9

Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and
demerits, series and parallel hybrid electric drive train design.

UNIT III - ELECTRIC PROPULSION SYSTEM AND MOTOR CONTROL 9

DC Motors, AC Motors, Permanent Magnet Motors, Brushless DC and Reluctance Motors, Characteristics,
Regenerative Braking, Control System Principles, speed and torque control – DC motors and AC Motors

UNIT IV - ENERGY STORAGES & GENERATORS 9

Electromechanical batteries – types of batteries – lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultra capacitors – DC Generators, AC Generators, Voltage and Frequency regulations.

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Unit V – FUEL CELLS & SOLAR CARS 9

Fuel Cell, Construction, Working, Equations, possible fuel sources, fuel reformer, design, solar cars, photovoltaic cells, tracking, efficiency and cost comparison, Plug In Vehicles(PIV).

Course Outcomes

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

CO1: Enumerate the layout of electric vehicle, system components and electronic control system.

CO2: Classify the various architecture of electric hybrid vehicles.

CO3: Exemplify the electric propulsion system and motor controlling Techniques.

CO4: Describe the energy storage system and generators in electric hybrid vehicle.

CO5: Explain the construction and working of fuel cells & solar cars.

Text Book(s):

1. Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, " Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design", CRC press, 2004
2. James Larminie and John Loury, " Electric Vehicle Technology – Explained", John Wiley & Sons Ltd,

Reference Book(s):

1. Sandeep Dhameja, "Electric Vehicle Battery Systems", Butterworth – Heinemann 2002.
2. Ronald K Jurgen, "Electric and Hybrid – Electric Vehicles", SAE, 2002.
3. Ron Hodkinson and John Fenton, "Light Weight Electric/Hybrid Vehicle Design",Butterworth – Heinemann, 2001.

Web References:

1. http://nptel.ac.in/courses/108103009/1
2. http://nptel.ac.in/courses/108103009/4
3. http://nptel.ac.in/courses/108103009/9
4. http://nptel.ac.in/courses/108103009/32
5. http://www.engnetbase.com/books/4675/3154fm.pdf

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Course Code: 16OE013	Course Title: SOLAR ENERGY SYSTEM	
Core/Elective: Open Elective	Credits (L:T:P:C:M)	3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours: 45	

Pre-requisites:

- Nil

Course Objectives

The course is intended to:

1. Understand the importance of solar radiation and its measurement techniques.
2. Understand the principles of solar Cooking, Distillation and Heating Systems.
3. Study the basic principles of solar photovoltaic (PV) cell and the factors affecting its electricity generation.
4. Understand the Balance of systems associated with PV power plants.
5. Design and study Stand alone and grid connected Solar PV systems.

UNIT I SOLAR RADIATION AND MEASUREMENTS 9

World Solar Energy - Indian Solar energy scenario-The sun and The Earth-Sun Earth Movement-Angle of Sunrays on solar collector-Sun tracking-Estimation of solar radiation empirically-Measurement of Solar Radiation.

UNIT-II SOLAR THERMAL TECHNOLOGIES 9

Solar Thermal Energy Systems-Absorption and Radiation-Solar Cooking Systems-Principle -Types of Solar Cooker-Solar Distillation System-Operation and design-Solar Heating Systems.

UNIT-III SOLAR PHOTOVOLTAIC TECHNOLOGIES 9

Solar photovoltaic(PV) energy conversion - Principles - Physics and operation of solar cells- Solar cell types and Technologies-Factors affecting electricity generated by solar cell-Solar PV modules-Ratings of PV module-Standard PV module parameters- Factors affecting electricity generated by PV module-Measuring Module

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Parameters-Solar Arrays-Connection of Modules in series, parallel and Series-parallel.

UNIT –IV BALANCE OF SYSTEMS 9

Batteries-Types-Parameters-Comparison of Various rechargeable batteries-Selection of Batteries-Batteries for PV Systems-Estimation of number of batteries required in series, parallel and series parallel for an application-Power Converters-Types-Charge Controllers-Function-Working-types-features-Typical Specifications-Maximum Power Point Tracking.

UNIT V SOLAR PV SYSTEM DESIGN AND INTEGRATION 9

Types of Solar PV systems-Design methodology for standalone Solar PV system-Configuration of Grid Connected Solar PV system-Components of Grid Connected Solar PV system-Design of Grid Connected Solar PV systems.

Course Outcomes:

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

CO1: Explain the importance of solar radiation and its measurement techniques.

CO2: Describe the principles of solar Cooking, Distillation and Heating Systems.

CO3: Explain the basic principles of solar photovoltaic (PV) cell and the factors affecting its electricity generation.

CO4: Describe the Balance of systems associated with PV power plants.

CO5: Design Stand alone and grid connected Solar PV systems.

Textbooks:

1. Solar Photovoltaic Technology and Systems A manual for Technicians, Trainers and Engineers -Chetan Singh Solanki-PHI Learning Private Limited-2013
2. Solar Energy Utilisation, G.D.Rai, Khanna Publishers, 1993.

Reference Books:

1. Solar Photovoltaics: Fundamentals, Technologies And Applications By Chetan Singh Solanki- PHI Learning Private Limited-2015
2. Solar Energy by S P Sukhatme, J K Nayak, Tata McGraw Hill Publishing, 2008
3. Renewable Energy Technologies: A Practical Guide for Beginners By Chetan Singh Solanki- PHI Learning Private Limited-2009

Websites:

1. http://www.pveducation.org/

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2. http://www.ese.iitb.ac.in/~chetan/PVmaterial.html
3. https://pveducation.com/
4. http://www.ncpre.iitb.ac.in/
5. https://mnre.gov.in/file-manager/UserFiles/support_hrd_coursematerial_iti.html

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Course Code: 16OE014	Course Title: ENERGY AUDITING AND CONSERVATION	
Core/Elective: Open Elective	**Credits (L:T:P:C:M)**	**3 : 0 : 0 : 3 : 100**
Type: Lecture	**Total Contact Hours:** 45	

Pre-requisites:

- Nil

Course Objectives
The course is intend to

1. Understand the basic principles of energy management material, energy balance
2. Study the financial and project management techniques for energy management
3. Gain knowledge in energy conservation of thermal utilities
4. Gain knowledge in energy conservation of electrical utilities
5. Analyze the performance of thermal and electrical utilities

UNIT I ENERGY MANAGEMENT & AUDIT 9

Energy Scenario-Basics of Energy and its various forms-**Energy Management & Audit:** Definition, Energy audit- need, Types of energy audit,Energy management (audit) approach-understanding energy costs, Bench marking,Energy performance, Matching energy use to requirement, Maximizing systemefficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments-**Material and Energy balance:** Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams.

UNIT II FINANCIAL& PROJECT MANAGEMENT 9

Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques-Simple pay back period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs.
Project Managemnet: Definition and scope of project, Technical design, Financing, Contracting,Implementation and performance monitoring: Implementation plan for top management,Planning Budget, Procurement Procedures, Construction, Measurement & Verification.

UNITIII ENERGY EFFICIENCY IN THERMALUTILITIES 10

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Boilers: Performances evaluation, Analysis of losses, Feed water treatment, Blow down, Energy conservation opportunities. **Steam System:** Properties of steam, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. **Waste Heat Recovery:** Classification, Advantages and applications, Commercially viable waste heat recovery devices, Saving potential-Introduction to cogeneration & furnaces

UNIT IV ENERGY EFFICIENCY ELECTRICAL UTILITIES **12**

Electric motors: Types, Losses in induction motors, Motor efficiency, Factors affecting motor performance, Energy saving opportunities with energy efficient motors. **Compressed air system:** Types of air compressors, Compressor efficiency, Capacity assessment, Leakage test, Factors affecting the performance and efficiency, **Fans and blowers**: Types, Performance evaluation, **Pumps and Pumping System**: Types, Performance evaluation,**Cooling Tower:** Types and performance evaluation, **Lighting System:** Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues.

UNIT V ENERGY PERFORMANCE ASSESSMENT CASE STUDIES **5**

Boilers-Heat Exchangers-Electric Motors –Fans and Motors-Compressors.

Course Outcomes:

At the end of the course the student can able to

CO 1: Explain the basic principles energy management and material, energy balance

CO2: Explain the financial and project management techniques for energy management

CO3: Identify the opportunities for energy conservation in thermal utilities

CO4: Identify the opportunities for energy conservation in electrical utilities

CO 5: Identify the improvement measures in the performance of thermal and electrical utilities

Text Books:

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

2. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006

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Reference Books:

1. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation"HemispherePubl, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford,1981.
3. I.G.C. Dryden, "The Efficient Use of Energy" Butterworths, London, 1982
4. W.C. turner, "Energy Management Hand book" Wiley, New York, 1982.

Web references:

1. http://www.em-ea.org/gbook1.asp

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Course Code: 16OET17	Course Title: SMART SENSOR TECHNOLOGY	
Open Elective	L : T : P : C :	3 : 0 : 0 : 3
Type: Theory	Total Contact hours :	45 Hours

Prerequisites: The student should have undergone the course(s):

- Nil

Course Objectives

The course is intended to:

1. Explain the Structure of Smart Sensors
2. Describe the data acquisition through the sensor
3. Elucidate the communication used for smart sensor
4. Illustrate the wireless communication technology used for smart sensor
5. Provide knowledge on inbuilt sensors in smart devices

UNIT I – INTRODUCTION TO SMART SENSORS 9

Mechanical to Electronic transition in Sensing – Nature of Sensor – Integration of Micromachining and Microelectronics - Evolution of Smart Sensors - Components of Smart Sensors – General Architecture of Smart Sensors

UNIT II – DATA ACQUISITION THROUGH SENSOR 9

Amplification and Signal Conditioning: Instrumentation amplifier – Sleep mode Circuitry - Rail to Rail operational amplifier - 4-20ma Signal transmitter – Digital conversion: sampling, Quantizing and encoding – MCU control and sensor interface – Techniques and system integration: Linearization – PWM Control – Auto zero and Auto range – Diagnostics – Reducing EMC and RFI

UNIT III – COMMUNICATION FOR SMART SENSOR 9

Overview of Communication Organization and standards – Automotive protocols: CAN – LIN – Media Oriented Systems Transport – Flex ray - Industrial usage of CAN – MCU with integrated CAN – LonTalk Protocol – MI bus – Other aspects of Network communications

UNIT IV – WIRELESS SENSING 9

Introduction of RF and Spread spectrum – Wireless data and communication – Zigbee – ANT+ - 6LoWPAN – NFC – Zwave – Dust networks – RF Sensing: Surface acoustic waves - RADAR – LIDAR – GPS – Remote emission sensing – Intelligent transportation system - RFID – Telemetry

UNIT V – SMART SENSOR DEVICES 9

Case Study: Sensors in Mobile phones: Accelerometer, Gyroscope, Touch sensor, Proximity Sensor, Ambient light sensor, Hall sensor and Finger print sensor – Sensors

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in Automotive vehicles: Air flow sensor, Engine speed sensor, Manifold Absolute Pressure Sensor, Spark Knock Sensor, Fuel Temperature Sensor, Voltage Sensorand ABS - Sensors in Wearables: Electro-chemical Bio Sensor, Wearable electrodes, Stain, temperature and pressure sensors

Course Outcomes

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

CO1. Explicate the Structure of Smart Sensors and build the sensor

CO2. Describe the data acquisition from sensor to other devices

CO3. Summarize the various communication protocol used for data processing

CO4. Elucidate wireless technology used in sensor system

CO5. Explain the sensors used in various smart devices

Text Books

1. Randy Frank "Understanding Smart Sensors" 3rd Edition, CRC Press, 2014
2. Krzysztof Iniewski "Smart Sensors for Industrial applications" CRC Press, 2013

Reference Books

1. Kevin Yallup, Krzysztof Iniewski "Technologies for Smart Sensors and Smart fusion" CRC Press, 2014
2. Gerard Meijer, Kofi Makinwa, MichielPertijs "Smart Sensor Systems: Emerging Technologies and applications" John wiley and Sons Ltd, 2014
3. S.C.Mukhopadhyay, G.S.Gupta "Smart Sensors and Sensing Technology" Springer, 2008

Web References

1. https://new.abb.com/motors-generators/service/advanced-services/smart-sensor
2. https://www.intersil.com/en/applications/industrial/smart-sensor.html
3. http://www.smartsensors.com/

Course Co-ordinator

HoD/EIE

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Head of the Department,
Department of Electronics and Instrumentation Engineering
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Pollachi - 642 003, Coimbatore District, Tamilnadu

Course Code: 16OET18	Course Title : INDUSTRIAL INTERNET OF THINGS	
Open Elective	L : T : P: C	3:0:0:3
Type: Theory	Total Contact hours:	45

Prerequisites:

- NIL

Course Objectives

The course is intended to:

1. Indicate the various industrial revolutions and architecture of IIoT.
2. Provide knowledge on Networking protocols used IoT based solutions
3. Realize an IoT application using physical devices and programming tools
4. Introduce the concept of process data analytics.
5. Provide an insight into the application of IIoT

UNIT I – Introduction and Architecture of IIoT 9

The Various Industrial Revolutions - Digitalisation and the Networked Economy -Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0-Comparison of Industry 4.0 Factory and Today's Factory -Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

IoT Architecture, WoT and M2M - IoT Enabling Technologies - IoT Levels and templates.

UNIT II – IoT Network protocols 9

Understanding Internet Protocols: Simplified OSI Model, Network Topologies, Standards, Salient features of IPV4 – Specifications of IPV6, Types of Internet Networking - Ethernet, WiFi, Bluetooth, Bluetooth Low Energy (BLE), Zigbee,6LoWPAN, RFID, NFC.

UNIT III – Physical And Logical Design 9

System Design of Connected Devices: Embedded Devices, Embedded Hardware, Connected Sensors and Actuators, Controllers, Battery Life Conservation and designing with Energy Efficient Devices, Physical design using prototyping boards - choice of processor, interfacing and networking - Logical Design – Open source platforms - Case study: Environmental monitoring using Python programming and Raspberry Pi prototyping board.

UNIT IV – PROCESS DATA ANALYTICS 9

Process analytics - Dimensions for Characterizing process- process Implementation technology Tools and Use Cases- open source and commercial tools for Process analytics- Big data Analytics for process data - Analyzing Big process data problem –

BoS Chairman

Head of the Department
Department of Electronics and Communication Engineering
Dr. Mahalingam College of Engineering and Technology
Pollachi - 642 003, Coimbatore District, Tamilnadu

Crowd sourcing and Social BPM - Process data management in the cloud.

UNIT V – CASE STUDY 9

Smart Manufacturing – IIoT in oil and gas industry -Smart Cities- Precision healthcare-Precision mining

Course Outcomes

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

CO1. Describe various industrial revolutions and architecture of IoT

CO2. Summarize the communication protocols suitable for IoT

CO3. Select suitable physical devices for IoT application

CO4. Describe the concept of process data analytics

CO5. Indicate the role and advantages of IIoT in various applications

Text Books

1. ArshdeepBahga and Vijay Madisetti, "Internet of Things A Hands-on Approach", Universities Press (India), 2015
2. Elizabeth Goodman, Alfred Lui,MartinCharlier, Ann Light, Claire Rowland Designing Connected Products, 1st Edition,O'Reilly Media Inc, 2015
3. Beheshti, S.-M.-R., Benatallah, B., Sakr, S., Grigori, D., Motahari-Nezhad, H.R., Barukh, M.C., Gater, A., Ryu, S.H. "Process Analytics Concepts and Techniques for Querying and Analyzing Process Data" Springer International Publishing Switzerland, 2016.

Reference Books

1. Lucas Darnell, "The Internet of Things (A Look at Real World Use Cases and Concerns)", Kindle Edition, 2016,
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
3. Joe Biron& Jonathan Follett "Foundational Elements of an IOT Solution - The Edge, Cloud and Application Development", O'reilly, First Edition, March 2016

Web References

1. https://onlinecourses.nptel.ac.in/noc17_cs22/preview
2. https://onlinecourses.nptel.ac.in/noc17_ee20/preview
3. https://www.udemy.com/internet-of-things-from-beginner-to-making-you-first-device/

Course Co-ordinator (L. JAYARAMAN)

HOD 25/2

BoS Chairman

OPEN ELECTIVES

Course Code: 16OET22	Course Title: OPEN SOURCE TECHNOLOGIES	
Elective	L : T : P : C	3:0:0:3
Type: Theory	Total Contact Hours:	45 Hours

Course Objectives

The course is intended to:

1. Explain the fundamental concepts of open source software.
2. Execute a real time application.
3. Implement the open source software packages.
4. Develop a shell script for an application.
5. Create a database to store real time data.

Unit I - INTRODUCTION TO OPEN SOURCE 6

GNU Operating System-Brief history of GNU -GNU Manifesto-Licenses -overview and usage of various Linux Distributions.

Unit II- LINUX COMMAND LINE 10

Starting with Linux Shells: Linux-Linux Distribution, Getting to the Shell: Reaching the Command Line- Accessing CLI via a Linux Console Terminal- Accessing CLI via Graphical Terminal Emulation- Using the GNOME Terminal Emulator- Using the Konsole Terminal Emulator- Using the xterm Terminal Emulator-Basic bash shell Command.

Unit III - SHELL SCRIPTING I 10

Basic Script Building: Using Multiple Commands-Creating a Script File-Displaying Messages-Using Variables-Redirecting Input and Output-Pipes-Performing Math-Exiting the Script. Using Structured Commands: Condition Statement-looping Statements.

Unit IV - SHELL SCRIPTING II 10

Handling user input- Creating Functions: Basic Script Functions- Returning a Value-Using Variables in Functions- Array Variables and Functions- Function Recursion-Creating a Library- Using Functions on the Command Line.

Unit V – PRODUCING SCRIPTS 9

Using a MySQL Database: Using MySQL- Using the database in scripts. Using the Web: Installing Lynx- The lynx command line- The Lynx configuration file- Capturing data from Lynx; Using E-Mail; Creating Little Shell Scripts.

Course Outcomes

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

CO1: Explain the fundamental concepts of open source software for a real world problem.
CO2: Execute a real time application using Linux commands.
CO3: Implement the open source software packages for real time problems.
CO4: Develop a shell script for an application using functions.
CO5: Create a database to store real time data using MySQL.

Text Book:

1. Richard Blum, Christine Bresnahan, "Linux Command Line and Shell Scripting BIBLE", Wiley 2015.

Reference Books:

1. Kailash Vadera , Bhavyesh Gandhi, "Open Source Technology",University Science press, 2009.
2. Andrew M. St. Laurent, "Understanding Open Source & Free Software Licensing: Guide to Navigating Licensing Issues in Existing & New Software", O'Reilly Publication, 2016.
3. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, "Linux in a nutshell", 6th Edition, OReilly media, September 2009.

Web References:

1. http://www.gnu.org/philosophy/
2. http://distrowatch.com/dwres.php?resource=major
3. http://tldp.org/guides.html

OBE Coordinator **BoS Convener** **BoS Chairman**

Course Code: 16OET24	Course Title: MULTIMEDIA SYSTEMS AND APPLICATIONS	
Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Course Objectives

The course is intended to:

1. Identify the suitable multimedia elements.
2. Examine the process involved in adding sound and animation.
3. Predict the video usage, hardware and software requirements.
4. Create the skills and process involved in making of multimedia project.
5. Formulate the web based multimedia application.

Unit I – INTRODUCTION TO MULTIMEDIA 9

Multimedia-Introduction, Multimedia Applications, Delivering Multimedia. Text-Fonts and Faces, Hypermedia and Hypertext. Images-Making Still Images, Color, Image file formats.

Unit II – SOUND AND ANIMATION 9

Sound-The power of Sound, Digital Audio, MIDI Audio, MIDI vs Digital Audio, Multimedia system sounds, Audio file formats, Adding Sound to Multimedia Project. Animation-The power of Motion, Principles of Animation, Animation by Computer, Animation Techniques.

Unit III - VIDEO AND MAKING MULTIMEDIA 9

Video-Using Video, Working of Video, Digital Video Containers. Making Multimedia-Stages of Multimedia Project, Intangibles, Hardware, Software, Authoring Systems.

Unit IV – PROCESS OF MAKING MULTIMEDIA 9

Multimedia Skills, Planning and Costing-The process of Making Multimedia, Scheduling, Estimating. Designing and Producing.

Unit V – INTERNET AND MULTIMEDIA 9

Internet and Multimedia-Internetworking, Multimedia on the Web, Designing for the World Wide Web-Developing for the Web, Delivering-Testing.

Course Outcomes

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

CO1: Identify the suitable multimedia elements for the multimedia applications.
CO2: Examine the process involved in adding sound and animation to multimedia project.
CO3: Predict the video usage, hardware and software requirements for making multimedia.
CO4: Create the skills and process involved in making of multimedia project using Gantt chart tool.
CO5: Formulate the multimedia concept for designing the web based application.

Text Book:

1. Tay Vaughan, "Multimedia : Making it work", 9th Edition, McGraw Hill, 2016.

Reference Books:

1. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Fifth Impression, Pearson Education, Asia, 2011.
2. .K.R.Rao, Zoran.S.Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication systems Techniques, Standards and networks", Eastern Economy Edition, 2002.

Web References:

1. www.cse.wustl.edu/~jain/refs/mul_refs.htm
2. http://guides.lib.umich.edu/c.php?g=282762&p=1884093
3. www.eduproindia.in/ multimedia-communications.html

OBE Coordinator **BoS Convener** **BoS Chairman**

Course Code: 16OET23	Course Title: ENTERPRISE RESOURCE PLANNING	
Elective	L : T : P : C	3:0:0:3
Type: Theory	Total Contact Hours:	45 Hours

Course Objectives

The course is intended to:

1. Identify the basic of ERP along with its benefits and risks.
2. Identify the ERP related technologies for business process.
3. Propose the Enterprise resource management technology.
4. Predict the implementation strategies & methodologies of ERP.
5. Create the various ERP related business modules.

Unit I – INTRODUCTION 9

Introduction to ERP – Basic ERP Concepts – Justifying ERP Investments: Quantifiable benefits, Intangible Benefits, Risks of ERP: People Issues, Process Risk, Technological Risks, Implementation Issues, Operation & Maintenance Issues, Managing Risks on ERP Projects.

Unit II - ERP AND TECHNOLOGY – I 9

ERP and Related Technologies: Business Intelligence, E- Commerce and E-Business, Business Process Reengineering (BPR), Data Warehousing & Data Mining.

Unit III - ERP AND TECHNOLOGY – II 9

On-line Analytical Processing(OLAP), Product Life Cycle Management(PLCM), Supply Chain Management(SCM), Customer Relationship Management(CRM), Advanced Technology and ERP Security.

Unit IV – ERP IMPLEMENTATION 9

Implementation Challenges – Implementation Strategies - Implementation life cycle – Implementation Methodologies - Project team.

Unit V – BUSINESS MODULES 9

Finance – Manufacturing – Human Resources – Plant Maintenance – Material Management – Quality Management – Marketing – Sales, Distribution and Services.

Course Outcomes

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

CO1: Identify the basic of ERP along with its benefits and risks for different projects.
CO2: Identify the ERP related technologies for business process from heterogeneous database.
CO3: Propose the Enterprise resource management technology for handling the ERP related security issues.
CO4: Predict the implementation strategies & methodologies of ERP for the different project team.
CO5: Create the various ERP related business modules for ERP Maintenance and management.

Text Book:

1. Alexis Leon, "ERP Demystified", 3rd Edition, Tata McGraw-Hill, 2014.

Reference Books:

1. Alexis Leon, "Enterprise Resource Planning", 3rd Edition, Tata McGraw-Hill, 2014.
2. Vinod Kumar Grag, N.K. Venkitakrishnan, "ERP- Concepts and Practice", 2nd Edition Prentice Hall of India, 2011.
3. Sinha P. Magal , Jeffery Word, "Essentials of Business Process and Information System", Wiley India, 2012.

Web References:

1. https://www.infosys.com/industries/high-technology/case-studies/Pages/oracle-implementation-global.aspx
2. https://www.odoo.com/
3. https://www.top10erp.org/Case-Study-Library.aspx

OBE Coordinator **BoS Convener** **BoS Chairman**

Course Code : 16OEXX	Course Title : Computer Application in Design for Mechatronics	
Core / Elective: Elective	L : T : P: C	3 : 0 : 0 : 3
Type: Theory	Total Contact hours:	45 Hours

Prerequisites: The student should have undergone the course(s):

- Engineering Graphics
- Engineering Mathematics

Course Objectives

The course is intended to:

1. Explain fundamentals of computer applications in design.
2. Explain CAD systems and its importance.
3. Describe fundamentals of computer graphics.
4. Describe different geometric modelling techniques used in CAD system.
5. Explain optimization principles.

UNIT I FUNDAMENTAL OF CAD **9 Hrs**

Introduction to CAD and Design process-Product cycle and CAD-Importance of Computer graphics and CAD-Reasons for implementing cad- conventional design vs CAD-Computer system hardware and software- Applications and benefits of CAD.

UNIT II CAD SYSTEM **9 Hrs**

CAD system configuration, Hardware -Display devices-Hard-copy devices- Interactive input devices-Display processors Software-Features-Graphic standards-GKS, PHIGS, IGES, STEP and PDES-Graphics and computing standards-data exchange standards-Design Database-Interfacing design and drafting.

UNIT III FUNDAMENTALS OF COMPUTER GRAPHICS **9 Hrs**

Homogeneous coordinate system-Output primitives and their attributes- 2D and 3D transformations:-scaling, translation, rotation, mirroring, clipping, shearing, scan conversion, Rasterisation- DDA & Bresenham's algorithm- circle generation.

UNIT IV GEOMETRICAL MODELING **9 Hrs**

Types & mathematical representation of curves, wire frame models- entities-representations- parametric representations – Curves - synthetic and analytic curves parametric representation of line and circle - Cubic splines and Bezier curves - concept of blending shape function -Surfaces & solids – model, entities, representations - fundamentals of surface and solid modeling - B-rep -constructive solid geometry (CSG) -analytical modeling - Boolean operation -Feature based Parametric and Vibrational modeling.

UNIT V OPTIMIZATION **9 Hrs**

Introduction- design synthesis - Engineering vs Optimum Design - Objectives of Optimization - Classification of Optimization problems and their procedure - techniques of optimization - Optimized design of machine components.

Course Outcomes

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

CO1: Explain fundamentals of computer applications in mechatronics system design.
CO2: Explain hardware and software used in CAD system.
CO3: Describe transformations and algorithms used in computer graphics.
CO4: Describe different geometric modelling techniques used in Mechatronics CAD System.
CO5:Explain optimization principles used in Mechatronics applications.

Text Books

1. CAD/CAM Theory & Practice by Ibrahim Zeid, Tata McGraw Hill,Second Edition, 2015.
2. Engineering Optimization: Theory and Practice -S.S. Rao, New Age International Publications, Third Edition, 2013.

Reference Books

1. CAD/CAM: Computer Aided design and Manufacturing by MikellGroover and Zimmer, Pearson Education, Fourth Edition ,2014.
2. Computer Graphics - Hearn & Baker, PHI, Second Edition,2002.
3. Mathematical Elements for Computer Graphics - David F. Rogers & J. Alan Adams, McGraw Hill, Second Edition, 2017

Web References

1. https://nptel.ac.in/courses/106106090/
2. https://nptel.ac.in/courses/106102065/

Course Code: 16OET05	Course Title: INDUSTRIAL ROBOTICS	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Nil

Course Objectives

The course is intended to:

1. Explain the basic concepts of Robots.
2. Describe different robotic components and its operations.
3. Explain various sensors and machine vision.
4. Apply different robot programming to actuate robots.
5. Explain the various industrial application of robots.

UNIT I INTRODUCTION 9

Definition of a Robot - Basic Concepts - Robot configurations - Types of Robot drive- Basic robot motions - Point to point control - Continuous path control.

UNIT II COMPONENTS AND OPERATION 9

Basic control system concepts - control system analysis - robot actuation and feedback, Manipulators – Forward and inverse kinematics, Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface.

UNIT III SENSING AND MACHINE VISION 9

Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis.

UNIT IV ROBOT PROGRAMMING 9

Methods - languages - Capabilities and limitation - Artificial intelligence - Knowledge representation - Search techniques – AI and Robotics.

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UNIT V INDUSTRIAL APPLICATIONS 9

Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM - Hostile and remote environments.

Course Outcomes

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

CO1: Explain the basic concepts of Robots used in various industries.

CO2: Describe different robotic components and its operations used in various industries.

CO3: Explain various sensors and machine vision used in various industrial robots.

CO4: Apply different robot programming to actuate robots for various industrial applications.

CO5: Explain the various industrial application of robots.

Text Books

1. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics - SIE: Technology - Programming and Applications ", 2nd edition, McGraw Hill Education, 2017.

2. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, " Robotics Engineering: An Integrated Approach ", Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.

References

1. Er.R.K.Rajput, "Robotics and Industrial Automation" 3rd edition S Chand Publishers, 2008.

2. S. R. Deb , Sankha Deb, "Robotics Technology and Flexible Automation" 2nd edition, McGraw Hill Education, 2017.

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Course Code: 16OET06	Course Title: AUTOMATION SYSTEMS	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes

Course Objectives

The course is intended to:

1. Describe the need of automation
2. Describe various pneumatic control elements
3. Describe the parts of PLC
4. Describe the PLC programming
5. Analyze different type of automation systems

UNIT I FUNDAMENTAL CONCEPTS OF AUTOMATION 9

History and developments in industrial automation, vertical integration of industrial automation, fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, and levels of automation control elements in industrial automation

UNIT II PNEUMATIC SYSTEMS 10

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and integration - sequential circuits - cascade methods - step counter method. Electrical elements to control pneumatic equipments - selection of components - design calculations -application - fault finding – low cost automation - robotic circuits.

UNIT III BASICS OF PROGRAMMABLE LOGIC CONTROLLERS 9

Basics of PLC, advantages, capabilities of PLC, architecture of PLC, scan cycle, types of plc, types of i/o modules, configuring a plc, plc wiring,

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UNIT IV PLC PROGRAMMING 10

Types of programming - simple process control programs using relay ladder logic - PLC arithmetic functions - timers and counters –data transfer-comparison and manipulation instructions

UNIT V CASE STUDIES 7

Case studies of machine automation, process automation, and selection parameters for PLC and real time interfacing

Course Outcomes

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

CO1: Describe the need of automation for industrial applications

CO2: Describe various pneumatic control elements for low cost automation.

CO3: Describe the functional parts of PLC used for automation

CO4: Develop logic programmes for real time applications using PLC

CO5: Analyze different type of systems such as machine and process automation

Text Books

1. Esposito Anthony, "Fluid Power with Applications",7th edition Pearson education inc., New York, 2013.
2. Petruzella, Frank D,"Programmable logic controllers", 5th edition, McGraw-Hill Companies, Inc 2018.

References

1. Devadas Shetty and Richard A.Kolk, "Mechatronics Systems Design", Cengage Learning Inc 2010.

Web references

- https://en.wikipedia.org/wiki/mechatronics
- http://www.cedrat.com/en/publications/categories/devicesystems/systems/mechatronics.html
- http://nptel.ac.in/courses/112103174/

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Course Code: 16OET07	Course Title: TOTAL QUALIY MANAGMENT	
Core/Elective: Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal Cutting Processes

Course Objectives

The course is intended to:

1. Explain the views of different quality gurus
2. Explain the principles and concepts inherent in a Total Quality Management (TQM) approach
3. Evaluate an industrial process
4. Explain the various quality tools for identifying appropriate process improvements
5. Explain the quality management

UNIT I INTRODUCTION **9**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II TQM PRINCIPLES **9**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure

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UNIT III STATISTICAL PROCESS CONTROL (SPC) 9

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV TQM TOOLS 9

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, overview of FMEA – Stages of FMEA

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 and Other Quality Systems, ISO 9000:2004 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits - AS9100 – introduction.

Course Outcomes

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

CO1: Explain the views of different quality gurus towards Total Quality Management.

CO2: Explain the principles and concepts inherent in a Total Quality Management (TQM) approach for managing a manufacturing or service organization

CO3: Evaluate an industrial process using control charts, process capability indices and six sigma.

CO4: Explain the various quality tools for identifying appropriate process improvements such as Bench marking, QFD,TPM and FMEA.

CO5: Explain the quality management with respect to the ISO 9000 & ISO 14000 quality management standards.

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Text Books

1. Dale H. Besterfiled, et al., "Total Quality Management", 5th edition, Pearson Education, Inc. 2014.
2. Subbaraj Ramasamy, "Total Quality Management" 2nd edition, McGraw-Hill, 2017.

References

1. James R.Evans& William M. Lidsay, "The Management and Control of Quality", 7th Ed., South-Western (Thomson Learning), 2009.
2. Oakland.J.S. "Total Quality Management", 4th edition, Routledge Ltd., 2014.

Web References

- https://en.wikipedia.org/wiki/Total_quality_management

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BoS Chairman

Course Code:	Course Title: MANUFACTURING INFORMATION SYSTEMS	
Core/Elective:Open Elective	L : T : P : C	3 : 0 : 0 : 3
Type: Theory	Total Contact Hours:	45 Hours

Prerequisites

The student should have undergone the course(s):

- Metal Forming, Joining and Casting Processes.
- Metal cutting Process

Course Objectives

The course is intended to:

1. Comprehend the information systems and networking.
2. Appreciate the product development and issues.
3. Understand the manufacturing models.
4. Identify the IT enabled process.
5. Know the resource planning.

UNIT I INFORMATION SYSTEMS AND NETWORKING (12)

Role of information technology in manufacturing: Role of internet, Intranet and extranet, present market constraints, extended enterprises, B2C and B2B. Types of server: Client/Server, architecture, database, data model, database management systems. Networking concepts: Networking devices, Network topologies, Wireless communication

UNIT II PRODUCT DEVELOPMENT AND ISSUES (9)

Software Engineering: Software development life-cycle, Product life cycle managementSequential engineering versus concurrent engineering - Global product - Product development – Quality assurance issues and complexity

UNIT III MANUFACTURING MODELS (9)

Engineer to order, make to order, assemble to order, made to stock, and configure to order. Faster design throughput: Web based design, changing design approaches, engineering change management, product configuration management. Enterprise application and integration for product lifecycle management, risk management - case studies

UNIT IV IT ENABLED PROCESS (8)

Process planning: Structure of process planning software, Information requirements for process planning.

UNIT V RESOURSE PLANNING (7)

Role of Manufacturing Resource Planning (MRP), Enterprise Resource Planning (ERP) – case studies

Course Outcomes

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

CO1: Comprehend the information systems and networking.
CO2: Appreciate the product development and issues.
CO3: Understand the manufacturing models.
CO4: Identify the IT enabled process.
CO5: Know the resource planning.

REFERENCES:

1. Franjo Cecelja," Manufacturing Information and Data systems, Design and Practice" Penton Press Publisher, 2002.
2. John Stark, "Global Product Strategy, Product Lifecycle Management and Billion Customer Question", Springer Publisher, 2007.
3. John Stark, "Product Lifecycle Management: 21st century for Product Realisation", Springer Publisher, 2005.
4. Radhakrishan P,Subramanyan P, Raju V, "CAD/CAM/CIM", New Age International Publishers, 2002.