ADITYA ENGINEERING COLLEGE

An Autonomous Institutuion

Approved by AICTE • Permanently Affiliated to JNTUK • Accredited by NAAC with 'A' Grade

Recognised by UGC under sections 2(f) and 12(B) of UGC Act, 1956

Aditya Nagar, ADB Road, Surampalem - 533437, Near Kakinada, E.G.Dt., Ph:99498 76662

Department of Electronics and Communication Engineering

M.Tech. (VLSI Design) - AR19 - Course Articulation Matrix

Note: Correlation Levels are 1 or 2 or 3. Where 1- Slight(Low), 2 - Moderate(Medium), 3 - Substantial (High).

	CO Statements	POs											PSOs		
I SEM															
Course Code	**192VD1T01-CMOS ANALOG IC DESIGN**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Demonstrate the small signal and large signal models of CMOS transistors.	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**
CO2	Analyze the characteristics of different CMOS circuits.	**1**	**3**	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**3**	**3**	**1**
CO3	Develop the two stage CMOS operational amplifiers.	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**2**	**-**
CO4	Analyze the basic comparator and different performance parameters of comparator.	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**
CO5	Develop basic circuits based on the knowledge acquired in the course	**2**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**-**
Course Code	**192VD1T02-CMOS DIGITAL IC DESIGN**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain the functionality of MOS inverters.	**-**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**
CO2	Analyze various combinational circuits designs in CMOS.	**2**	**3**	**2**	**-**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**-**
CO3	Analyze sequential logic gates designs in CMOS.	**2**	**3**	**2**	**-**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**-**
CO4	Explain the functionality of different arithmetic building blocks.	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**
CO5	Analyze different semiconductor memories.	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**1**

	CO Statements	POs											PSOs		
Course Code	**192VD1E01-VLSI TECHNOLOGY (PROFESSIONAL ELECTIVE – I)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Summarize characteristics of MOS transistors.	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**
CO2	Outline the MOS fabrication process and short channel effects.	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**
CO3	Identify the basic rules in layout designing.	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**
CO4	Analyze various combinational logic networks and sequential systems.	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**
Course Code	**192VD1E02-NANOMATERIALS AND NANOTECHNOLOGY (PROFESSIONAL ELECTIVE – I)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Understand the basic science behind the design and fabrication of nano scale systems.	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**2**	**1**	**-**
CO2	Understand and formulate new engineering solutions for current problems and competing technologies for future applications.	**1**	**3**	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**3**	**3**	**1**
CO3	Develop the inter disciplinary projects applicable to wide areas by clearing and fixing the boundaries in system development.	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**1**
CO4	Dissect the operation of fabrication and characterization	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
CO5	Apply knowledge of science and Engineering	**1**	**2**	**1**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**2**	**-**
Course Code	**192VD1E03-MEMS TECHNOLOGY (PROFESSIONAL ELECTIVE – I)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Summarise the basic concepts of MEMS technology and working of MEMS devices	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**
CO2	Relate different materials for current MEMS devices and competing Technologies for future applications	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**
CO3	Summarise the concepts of fabrication process of MEMS, Design and Packaging Methodology	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**

	CO Statements	POs											PSOs		
CO4	Analyse the various fabrication techniques in the manufacturing of MEMS Devices	-	-	2	-	-	-	-	-	-	-	-	1	-	3
Course Code	**192VD1E04-DEVICE MODELLING (PROFESSIONAL ELECTIVE – II)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Understand the physics of 2-terminal MOS operation and its characteristics.	-	1	-	2	2	-	-	-	-	-	-	2	1	-
CO2	Understand the physics of 4-terminal MOSFET operation and its characteristics.	-	1	-	-	2	-	-	-	-	-	-	2	1	-
CO3	Analyze the SOI MOSFET electrical characteristics.	-	3	-	-	3	-	-	-	-	-	-	3	3	1
CO4	Interpret various MOSFET models.	-	3	-	-	3	-	-	-	-	-	-	3	3	1
CO5	Analyse various high k dielectrics.	-	3	-	-	-	-	-	-	-	-	-	3	3	-
Course Code	**192VD1E05-NANO-ELECTRONICS (PROFESSIONAL ELECTIVE – II)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Demonstrate challenges due to scaling on CMOS devices.	-	3	-	2	2	3	-	1	1	1	3	2	1	-
CO2	Analyse and explain working of novel MOS based silicon devices and various multi gate devices.	2	3	2	2	2	3	-	1	1	1	3	2	3	1
CO3	Analyse working of spin electronic devices	2	3	2	2	2	3	-	1	1	1	3	2	3	1
CO4	Summarize nano electronics systems and building blocks such as: low dimensional semiconductors, hetero structures, carbon nano tubes, quantum dots, nanowires etc.	1	2	-	3	-	-	-	-	-	-	-	2	1	-
CO5	Develop nano electronics systems and building blocks such as: carbon nanotubes, quantum dots, nanowires etc.	-	2	-	3	3	2	-	2	2	2	2	3	2	-
CO6	Explain various design methodologies for chip design.	3	2	3	1	1	2	1	-	-	-	2	1	2	2
Course Code	**192VD1E06-PHOTONICS (PROFESSIONAL ELECTIVE – II)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Classify the Optical sources and detectors and to discuss their principle.	2	1	-	-	-	-	-	1	-	-	-	2	1	-
CO2	Understand the Design considerations of fiber optic systems.	1	2	1	-	-	-	-	-	-	-	-	2	1	-
CO3	Analyse the basic methodologies behind the manufacturing of different LED materials.	2	3	1	-	-	-	-	-	-	-	-	2	3	-

	CO Statements	POs											PSOs		
CO4	Apply the principles of atomic physics to materials used in optics and photonics.	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**
CO5	Use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**
Course Code	**192HS1T01-RESEARCH METHODOLOGY AND IPR**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Understand research problem formulation.	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Analyze research related information.	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO3	Demonstrate research ethics	**2**	**1**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**-**	**-**	**2**	**3**	**-**
CO4	Explain the today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.	**-**	**-**	**-**	**-**	**-**	**2**	**3**		**-**	**-**	**-**	**2**	**2**	**-**
CO5	Discuss that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**-**
CO6	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**
Course Code	**192VD1L01-CMOS ANALOG IC DESIGN LAB**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Make use of the CAD Tool in modeling CMOS analog circuits.	**-**	**2**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	Outline the circuit behavior based on different input conditions.	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**2**	**-**
CO3	Interpret the electrical parameters of CMOS analog circuits.	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**-**	**-**
CO4	Examine the Layout diagrams that are drawn by using EDA Tools.	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**
Course Code	**192VD1L02-CMOS DIGITAL IC DESIGN LAB**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Identify different VLSI Design Methodologies using Mentor Graphics Tools.	**-**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**3**
CO2	Compare schematics for all digital designs and implement using simulation tools.	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

	CO Statements	POs											PSOs		
CO3	Discover layouts physically through various Back end EDA Tools.	**-**	**-**	**2**	**3**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**2**	**2**	**3**
CO4	Examine the performance extracted layouts through DRC, LVS, and PEX.	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**3**
CO5	Evaluate the performance of combinational and sequential designs for its speed and other performance parameters.	**3**	**3**	**3**	**3**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
II SEM															
Course Code	**192VD2T03-MIXED SIGNAL AND RF IC DESIGN**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Design basic cells like Op-Amp, against process and temperature variations meeting the mixed signal specifications.	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**
CO2	Design comparators that can meet the high speed requirements of digital circuitry.	**-**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**
CO3	Design a complete mixed signal system that includes efficient data conversion and RF circuits with minimizing switching.	**-**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Understand the design bottlenecks specific to RF IC design, linearity related issues and ISI.	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**
CO5	Outline different multiple access techniques, wireless standards and various transceiver architectures.	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
Course Code	**192VD2T04-PHYSICAL DESIGN AUTOMATION**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Understand the relationship between design automation algorithms and various constraints posed by VLSI fabrication and design technology.	**-**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO2	Adapt the design algorithms to meet the critical design parameters.	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	Identify layout optimization techniques and map them to the algorithms	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Develop proto-type EDA tool and test its efficacy	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
CO5	Analyze the different partitioning algorithms and its evolution	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
Course Code	**192VD2E07-DESIGN FOR TESTABILITY (PROFESSIONAL ELECTIVE – III)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Demonstrate advanced knowledge in the basic faults that occur in digital systems, Testing of stuck at faults for digital circuits, Design for testability.	-	1	-	-	-	-	-	-	-	-	-	2	1	-
CO2	Analyse testing issues in the field of digital system design critically for conducting research.	2	3	2	-	-	3	-	-	-	-	-	3	3	-
CO3	Solve engineering problems by modelling different faults for fault free simulation in digital circuits.	-	-	3	-	-	-	3	-	-	-	-	3	-	3
CO4	Apply appropriate research methodologies and techniques to develop new testing strategies for digital and mixed signal circuits and systems.	1	2	1	-	-	2	-	-	-	-	-	3	2	-
Course Code	**192VD2E08-IoT AND ITS APPLICATIONS (PROFESSIONAL ELECTIVE – III)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain the various technologies in IoT Architectures and IoT Platforms.	3	1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	Apply Different Layer Protocols for building an IoT Network for the Applications.	1	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	Develop an IoT Applications using appropriate software's and hardware's.	1	2	1	-	-	-	-	-	-	-	-	3	2	-
CO4	Analyze the Data flow in the IoT Networks with appropriate frameworks.	-	-	2	-	3	-	-	-	-	-	-	-	3	1
CO5	Analyze the real time IoT Applications with different case studies.	-	3	2	-	3	-	-	-	-	-	-	3	3	1
Course Code	**192VD2E09-VLSI SIGNAL PROCESSING (PROFESSIONAL ELECTIVE – III)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain parallel and pipelining processing techniques.	2	3	3	-	3	3	-	3	-	-	-	2	-	-
CO2	Identify applications for unfolding algorithm.	3	1	-	-	2	-	-	-	-	-	-	3	-	-
CO3	Analyse Systolic Design for Space Representations containing Delays.	3	3	2	-	-	-	-	-	-	-	-	3	-	-
CO4	Explain Cook-Toom Algorithm, Fast Convolution algorithm by Inspection method.	2	1	1	-	2	-	-	-	-	-	-	2	-	-
CO5	Analyse Power Reduction techniques and Power Estimation techniques.	3	3	2	-	-	-	-	3	-	-	-	4	-	1

	CO Statements	POs											PSOs		
Course Code	**192VD2E10-MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS (PROFESSIONAL ELECTIVE – IV)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Develop the moderate complex programs for embedded applications.	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
CO2	Compare the different ARM processor core based SoC with several features/ peripherals based on requirements of embedded applications.	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO3	Analyze the architectures in Programmable DSP processors.	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Distinguish the different types of TMS320C6000 family	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO5	Develop digital signal processing applications using code composer studio.	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
Course Code	**192EM2E11-NETWORK SECURITY & CRYPTOGRAPHY (PROFESSIONAL ELECTIVE – IV)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain basic concepts of encryption techniques.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**3**	**3**	**-**	**-**	**2**	**1**	**-**
CO2	Identify and utilize different forms of cryptography techniques	**1**	**2**	**1**	**3**	**3**	**2**	**-**	**3**	**3**	**-**	**-**	**3**	**2**	**1**
CO3	Illustrate authentication requirements with algorithms.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**3**	**3**	**-**	**-**	**2**	**1**	**-**
CO4	Apply authentication and security in the network applications	**1**	**2**	**1**	**3**	**3**	**2**	**-**	**3**	**3**	**-**	**-**	**3**	**2**	**-**
CO5	Compare different types of threats to the system and handle the same	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**3**	**3**	**-**	**-**	**2**	**1**	**-**
Course Code	**192VD2E11-LOW POWER VLSI DESIGN (PROFESSIONAL ELECTIVE – IV)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Make use of the concepts of Low-Power Design Approaches in complex systems design.	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**2**
CO2	Contrast different Low-Voltage Low-Power design approaches for a target design.	**-**	**3**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO3	Inspect the low power methods to get the circuits for reduced power dissipation.	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**
CO4	Choose the suitable design among the list of Low-Voltage Low-Power Adders or Multipliers.	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**

	CO Statements	POs											PSOs		
CO5	Extend the knowledge of power management strategies in power efficient VLSI design.	**-**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**1**
Course Code	**192VDL03-MIXED SIGNAL IC DESIGN LAB**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Design the compensated op-amp with resistor and miller compensation.	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**
CO2	Explain the operation of comparator through the two stage cross coupled clamped comparator.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**
CO3	Design the switched capacitor circuit using parasitic sensitive integrator and parasitic insensitive integrator	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**
CO4	Demonstrate the operation of PLL and VCO through its design.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**
CO5	Explain the operation layouts of all the circuits that are designed and simulated.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**
Course Code	**192VD2L04-PHYSICAL DESIGN AUTOMATION LAB**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Contrast the fluency in designing Algorithms.	**2**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**
CO2	Create and run scripts using C, C++ Programming Language.	**2**	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**
CO3	Analyze methods of Floor Planning & Routing Algorithms.	**-**	**1**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**
III SEM															
Course Code	**192VD3E12-SCRIPTING LANGUAGES FOR VLSI (PROFESSIONAL ELECTIVE – V)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Contrast the fluency in programming with scripting languages.	**2**	**-**	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	**3**	**3**	**1**
CO2	Create and run scripts using PERL/ TCL/ PYTHON in CAD Tools.	**2**	**3**	**2**	**-**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**3**	**3**	**1**
CO3	Identify the use of PERL/PYTHON/ TCL in developing system and web applications.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**3**	**-**	**-**	**1**	**2**	**1**	**-**
CO4	Analyze methods for Libraries and Packages.	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**

	CO Statements	POs											PSOs		
CO5	Identify Programming Languages With Syntaxes.	**-**	**3**	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**2**
Course Code	**192VD3E13-DIGITAL SYSTEM DESIGN AND VERIFICATION (PROFESSIONAL ELECTIVE – V)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Analyse the functionality of the basic building blocks of a digital system.	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	Model the digital systems and test bech using Verilog and VHDL.	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**
CO3	Apply front end design and verification techniques and create reusable test environments.	**1**	**-**	**1**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**
CO4	Analyze the Current challenges in physical design and process effects.	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO5	Explain PLD's and FPGA architectures with use of VLSI Design issues, and design Processes.	**2**	**-**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**
Course Code	**192EM3E14-HARDWARE SOFTWARE CO-DESIGN (PROFESSIONAL ELECTIVE – V)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Analyze embedded system's hardware and software design issues.	**2**	**3**	**-**	**3**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**3**	**3**	**1**
CO2	Develop the applications on 8051, ADSP2106 and TMS320C60 processors	**-**	**2**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**-**
CO3	Demonstrate modern embedded architectures and compilation technologies.	**-**	**1**	**-**	**2**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**2**	**1**
CO4	Interpret the Design, co design by using design verification tools.	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**1**	**2**	**1**	**-**
CO5	Build the system from system level specification languages	**-**	**2**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
Course Code	**192ST3O01-REPAIR AND REHABILITATION OF STRUCTURES (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Identify the causes of deterioration of concrete structures.	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Illustrate the various materials for repair and rehabilitation techniques.	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Construct the various strengthening and stabilization techniques.	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
CO4	Determine various repair techniques of damaged structures.	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Evaluate the usage of different types of concretes and durability aspects.	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO6	Classify the usage of high performance concretes for repairing works.	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192ST3O02-GREEN BUILDING SYSTEMS (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain the principles of green building planning, its bylaws.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Explain the concepts of green building materials.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Use concept of energy and resource conversion in green building construction.	**1**	**2**	**1**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Use of renewable energy resources in green building design.	**2**	**3**	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Design climate for green buildings.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192ST3O03-BASIC CONCRETE TECHNOLOGY (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain the properties and tests on cement.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Classify the different types of aggregates.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Outline the mixing of Fresh concrete.	**1**	**2**	**1**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Interpret the various tests on workability of Fresh concrete.	**2**	**3**	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Demonstrate the behaviour of hardened concrete.	**-**	**1**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192ST3O04-BASIC FOUNDATION ENGINEERING (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Recognize the types of available foundations for different structures.	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Classify the given soil based on index and engineering properties.	**1**	**3**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
CO3	Interpret the shear strength of cohesive and cohesionless soils.	**1**	**2**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Analyse a shallow foundation for a given soil condition and loading.	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Analyse a deep foundation for a given loading and soil conditions.	**-**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192PD3O01-RENEWABLE ENERGY TECHNOLOGIES (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Identify alternate energy sources.	**1**		**-**	**2**		**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
CO2	Analyze and design induction generator for power generation from wind.	**-**		**-**		**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
CO3	Analyze different wind power plants.	**2**	**3**	**3**	**3**		**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO4	Design MPPT controller for solar power utilization.	**3**		**-**		**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Illustrate the basic operation of fuel cells	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192PD3O02-HYBRID ELECTRIC VEHICLES (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Illustrate the performance characteristics of converter fed DC drives.	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**
CO2	Analyze the two quadrants and four quadrant controls of DC motor drives.	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**
CO3	Develop the mathematical models of DC drive components	**1**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Analyze the four quadrant and closed loop control of DC-DC converter fed DC drive.	**2**	**3**	**3**	**3**	**1**	**-**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	Propose various controlling techniques of DC drives for industrial applications.	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**-**
CO6	Design various power electronic converters to control the DC motors	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**-**
Course Code	**192PD3O03-ENERGY AUDIT AND CONSERVATION AND MANAGEMENT (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain energy efficiency, conservation and various technologies.	**2**	**1**	**-**	**-**	**2**	**2**	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
CO2	Design energy efficient lighting systems.	-	-	-	-	2	2	3	-	-	3	-	-	-	-
CO3	Calculate power factor of systems and propose suitable compensation techniques.	2	-	-	-	-	-	3	-	-	-	-	-	-	-
CO4	Explain energy conservation in HVAC systems	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	Calculate life cycle costing analysis and return on investment on energy efficient technologies.	3	3	-	2	3	-	3	-	-	1	-	-	-	-
Course Code	**192PD3O04-NEURAL NETWORKS AND FUZZY LOGIC (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Demonstrate different models of artificial neuron.	2	1	-	-	2	-	-	-	-	-	-	-	-	-
CO2	Identify various learning methods of ANN.	3	2	1	1	3	-	-	-	-	-	-	-	-	-
CO3	Analyze the various feed forward neural networks and Hopfield Network	3	3	2	2	2	-	-	-	-	-	-	-	-	-
CO4	Compare and Contrast Classical and Fuzzy sets.	2	1	-	-	2	-	-	-	-	-	-	-	-	-
CO5	Utilize different modules of Fuzzy Logic Controller for rule base and decision making Systems	3	2	1	1	3	-	-	-	-	-	-	-	-	-
CO6	Analyze the application of fuzzy logic control to real time systems	3	3	2	2	2	-	-	-	-	-	-	-	-	-
Course Code	**192PD3O05-INDUSTRIAL SAFETY (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Understand the general industrial requirements like lighting, cleanliness prevention from hazards and accidents.	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	Analyze maintenance requirements of the industry and cost associated.	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	Analyze wear and corrosion aspects of the industry and their prevention.	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	Identify the faults prone areas and their repair and periodic maintenance	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Code	**192PD3O06-COMPOSITE MATERIALS (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Understand characteristics and advantages of composite materials	2	-	-	-	-	-	-	-	-	-	-	-	-	-

	CO Statements	POs											PSOs		
CO2	Acquire knowledge of reinforcement, glass fiber, etc.	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	Identify the usage of metal matrix composites	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	Understand manufacturing of polymer matrix composites	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	Identify different types of failures.	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Course Code	**192TE3O01-ENERGY SYSTEMS (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain the working principle of various energy systems.	2	-	-	-	-	1	-	-	-	-	-	-	-	-
CO2	Calculate the availability analysis of the energy systems and cycles.	2	1	2	-	-	1	-	-	-	-	-	-	-	-
CO3	Explain the design and working principles of combustion systems.	2	1	1	-	-	1	-	-	-	-	-	-	-	-
CO4	Explain the thermal energy auditing technologies and procedures.	2	1	1	-	-	1	-	-	-	-	-	-	-	-
CO5	Analyse various types of energy storage devices and perform the selection based on techno-economic view point.	2	1	1	1	-	1	-	-	1	1	-	-	-	-
CO6	Explain various measurement techniques useful for the evaluation of Energy Conservation Schemes.	2	-	1	-	-	1	-	-	1	1	-	-	-	-
Course Code	**192TE3O02-FUELS AND COMBUSTION (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain detailed classification of solid fuels and their conversion process.	1	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	Differentiate various rate of reactions.	1	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	Evaluate thermodynamics related to combustion process.	3	2	2	2	-	-	-	-	1	-	1	-	-	-
CO4	Explain the parameters involved in Flame propagation.	1	1	1	1	-	-	-	-	-	-	-	-	-	-
CO5	Identify the various sources of air pollution.	1	1	1	1	-	-	-	-	-	-	-	-	-	-

	CO Statements	POs											PSOs		
Course Code	**192TE3O03-GREEN ENGINEERING TECHNOLOGY (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Distinguish the various solar energy collection methods and measuring instruments.	**3**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**-**	**-**
CO2	Explain the different methods of solar energy storage and their applications	**3**	**3**	**1**	**3**	**-**	**-**	**1**	**-**	**3**	**3**	**-**	**-**	**-**	**-**
CO3	Illustrate the various types of wind mills and performance characteristics.	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**2**	**2**	**-**	**-**	**-**	**-**
CO4	Explain the principle of Biomass production, Geothermal energy sources and Ocean thermal energy conversion	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**2**	**2**	**-**	**-**	**-**	**-**
CO5	Illustrate the various types of electrical systems and mechanical systems.	**1**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**1**	**-**	**-**	**-**	**-**
CO6	Compare the various energy efficient process	**2**	**1**	**1**	**1**	**-**	**-**	**2**	**-**	**2**	**2**	**-**	**-**	**-**	**-**
Course Code	**192TE3O04-IC ENGINES (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Predict the engine combustion characteristics.	**3**	**3**	**2**	**3**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Evaluate engine performance	**3**	**3**	**2**	**3**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Interpret the formation of engine emission and their control strategies	**3**	**3**	**2**	**3**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Distinguish the usage of different alternative fuels and their compatibility with fossil fuels	**3**	**3**	**3**	**3**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Explain the constructional and working principles of electrical vehicle and their accessories	**1**	**2**	**1**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192TE3O05-AUTOMOTIVE TECHNOLOGY (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Summarize the vehicle chassis layout and constructional features of vehicle body.	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**
CO2	Explain the constructional and working principles of sprung masses	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**
CO3	Explain the constructional and working principles of unsprung masses.	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
CO4	Summarize the functionalities of various electrical systems of a typical automobile.	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**
Course Code	**192ES3O01-EMBEDDED SYSTEM DESIGN (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Apply processor based embedded system design concepts to develop an embedded system.	**1**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Analyze the hardware components, processor performance of an embedded system design.	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Make use of operating systems and embedded programming languages to develop a real-time system.	**1**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Utilize modern development tools, CAD tools for integrating software and hardware components in embedded system designs.	**1**	**2**	**1**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Develop an embedded system by understanding the various processor architecture case studies along with its applications.	**1**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192ES3O02-DIGITAL SYSTEM DESIGN (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Examine CAMP Algorithms for minimizing the complexity of digital system design.	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Simplify digital circuits using PLA minimization algorithm (IISc algorithm) and PLA folding algorithm	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Construct digital circuits using CPLDs, FPGAs and ASICs.	**1**	**2**	**1**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Analyze the functionality of combinational circuits using different fault diagnosis & test methods	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Analyze the testing aspects and fault diagnosis methods of sequential circuits	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192ES3O03-PROGRAMMING LANGUAGES FOR EMBEDDED SYSTEMS (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Develop the moderate complex programs in embedded C.	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Compare the different programming techniques in object-oriented programming	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
CO3	Analyze the algorithm in C++.	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Distinguish the different types of overloading & Inheritance	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Understand the templates and scripting languages	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192ES3O04-SENSORS AND ACTUATORS (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Classify various sensors/transducers based on their applications	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Dissect various types of Resistive, Inductive and Capacitive Sensors.	**2**	**3**	**-**	**3**	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**
CO3	Analyze various approaches, procedures and results related to Thermal and Magnetic sensors	**2**	**3**	**2**	**3**	**3**	**1**	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**
CO4	Examine the radiation sensors based on their characteristics	**2**	**3**	**2**	**3**	**3**	**-**	**2**	**-**	**3**	**-**	**3**	**-**	**-**	**-**
CO5	Apply Smart Sensors in the field of Communication, Automation and Manufacturing	**1**	**3**	**1**	**3**	**3**	**2**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**
CO6	Perceive various control values and types of actuators	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**
Course Code	**192VD3O01-PHYSICAL DESIGN AUTOMATION (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Understand the relationship between design automation algorithms and various constraints posed by VLSI fabrication and design technology	**-**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Adapt the design algorithms to meet the critical design parameters.	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Identify layout optimization techniques and map them to the algorithms	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Develop proto-type EDA tool and test its efficiency	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Analyze the different partitioning algorithms and its evolution	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192VD3O02-VLSI TECHNOLOGY (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Summarize characteristics of MOS transistors.	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
CO2	Outline the MOS fabrication process and short channel effects.	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Identify the basic rules in layout designing	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Analyze various combinational logic networks and sequential systems	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192VD3O03-NANO-ELECTRONICS (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Demonstrate challenges due to scaling on CMOS devices	**-**	**3**	**-**	**2**	**2**	**3**	**-**	**1**	**1**	**1**	**3**	**-**	**-**	**-**
CO2	Analyse and explain working of novel MOS based silicon devices and various multi gate devices	**2**	**3**	**2**	**2**	**2**	**3**	**-**	**1**	**1**	**1**	**3**	**-**	**-**	**-**
CO3	Analyse working of spin electronic devices	**2**	**3**	**2**	**2**	**2**	**3**	**-**	**1**	**1**	**1**	**3**	**-**	**-**	**-**
CO4	Summarize nano electronics systems and building blocks such as: low dimensional semiconductors, hetero structures, carbon nano tubes, quantum dots, nanowires etc.	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Develop nano electronics systems and building blocks such as: carbon nanotubes, quantum dots, nanowires etc.	**-**	**2**	**-**	**3**	**3**	**2**	**-**	**2**	**2**	**2**	**2**	**-**	**-**	**-**
CO6	Explain various design methodologies for chip design.	**3**	**2**	**3**	**1**	**1**	**2**	**1**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
Course Code	**192CS3O01-PYTHON PROGRAMMING (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Apply fundamental concepts of Python programming language.	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Develop programs using control statements.	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Use data structures in Python to solve various problems.	**-**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**
CO4	Develop programs using functions, strings and files.	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Make Use of Standard libraries like math, turtle, tkinter, re etc. in building real time applications.	**-**	**-**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**
CO6	Discuss on Object Oriented Programming concepts and Exceptions.	**-**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
CO7	Design various applications using database connectivity.	**3**	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
Course Code	**192CS3O02-PRINCIPLES OF CYBER SECURITY (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Illustrate cybercrime fundamentals.	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Analyze cyber offence planning.	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Interpret cybercrime on mobile and wireless devices.	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Distinguish type of tools and methods used in cyber crimes.	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Explain the importance of cyber security.	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192CS3O03-INTERNET OF THINGS (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Summarize on the term 'internet of things' in different contexts.	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Analyze various protocols for IoT.	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Design a PoC of an IoT system using Rasperry Pi/Arduino.	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Apply data analytics and use cloud offerings related to IoT.	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Analyze applications of IoT in real time scenario.	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192CS3O04-MACHINE LEARNING (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Apply Domain Knowledge for Productive use of Machine Learning and Diversity of Data	**3**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Demonstrate on Supervised and Computational Learning problems	**3**	**2**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Analyze on Statistics in learning techniques and Logistic Regression	**3**	**2**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Illustrate on Support Vector Machines and Perceptron Algorithm	**3**	**2**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
CO5	Design a Multilayer Perceptron Networks and classification of decision tree.	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192CS3O05-ARTIFICIAL INTELLIGENCE (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Describe the fundamentals of Artificial Intelligence and its applications.	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Illustrate the time and space complexities of searching techniques.	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Apply various logical systems to inference the different logical problems	**3**	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Create knowledge structure using traditional and complex structures and Advanced knowledge representation techniques	**3**	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Apply Fuzzy Logic and Reasoning to handle Uncertainty for solving scientific Problems	**3**	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192CS3O06-DEEP LEARNING (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Demonstrate the basic concepts fundamental learning techniques and layers.	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Discuss the Neural Network training, various random models.	**-**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Identify different types of deep learning network models.	**1**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Classify the Probabilistic Neural Networks.	**1**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Implement tools on Deep Learning techniques.	**1**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192PE3O01-INTRODUCTION TO PETROLEUM ENGINEERING (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Understand the role of petroleum engineers in various facets of petroleum exploration, production, transportation, refining and processing	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Summerise the energy security after knowing the present scenario of petroleum and natural gas.	**2**	**2**	**1**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Analyze various case studies available in petrochemical, fine chemical, bioprocesses and carbon capture.	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
CO4	Explain the principal involved in gathering oil and gas storage.	**3**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Understand the basic concepts of Downstream processing.	**2**	**2**	**-**	**2**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**-**	**-**
Course Code	**192PE3O02-PROCESS INTENSIFICATION (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Apply the basic principles and mechanisms that are responsible for process intensification.	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Analyze various modifications to process equipment and designs with which process intensification becomes a reality in unit operations and unit processes	**2**	**2**	**1**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Analyze various case studies available in petrochemical, fine chemical, bioprocesses and carbon capture	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Correlate textbook reported methodologies with Computational Fluid Dynamics.	**3**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Correlate textbook reported methodologies with experimental process intensification.	**2**	**2**	**-**	**2**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**-**	**-**
Course Code	**192PE3O03-FUNDAMENTALS OF LIQUEFIED NATURAL GAS (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain the LNG value chain.	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Classify the different liquefaction technologies of LNG.	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Explain the components of LNG receiving terminals.	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Summarize LNG storage and transportation facilities	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Identify major equipment and safety aspects of LNG industry.	**3**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Course Code	**192PE3O04-SUBSEA ENGINEERING (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain Overall View of subsea engineering.	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Explain the Subsea Distribution System	**-**	**3**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**

	CO Statements	POs											PSOs		
CO3	Identification and monitoring of Subsea Control.	**2**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Explain Subsea Power Supply, Subsea systems engineering	**1**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Infer the Hydrates, Wax and Asphaltenes	**-**	**-**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
Course Code	**192PE3O05-GEOLOGY (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain the general facts of the earth.	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	Analyze the different processes for the formation of land forms.	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Analyze the different structures like folds, faults etc.	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	Compare and classify various kinds of rocks.	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Explain the process of transportation, generation of sedimentary structures	**2**	**2**	**-**	**2**	**1**	**-**	**2**	**-**	**-**	**2**	**1**	**-**	**-**	**-**
Course Code	**192PE3O06-HSE IN PETROLEUM INDUSTRY (OPEN ELECTIVE)**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	Explain the environmental issues in drilling and production operations.	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**3**	**1**	**-**	**-**	**-**	**-**	**-**
CO2	Summarize impacts of petroleum industry wastes and waste treatment methods	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	Demonstrate the oil mines regulations in various petroleum industry operations	**-**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO4	Make use of the hazop study concepts for safe practices in Petroleum industry	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	Illustrate the fire triangle, different methods of suppression of hydrocarbon fires	**-**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**