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Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Post S.S.C Diploma Courses

Programme Name	**: Diploma In Electronics & Tele-communication Engg.**		
Programme Code	**: EJ**	**With Effect From Academic Year**	**: 2023-24**
Duration Of Programme	**: 6 Semester**	**Duration**	**: 16 WEEKS**
Semester	**: Sixth** **NCrF Entry Level : 4.0**	**Scheme**	**: K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme												
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning		Total Marks
																	Practical						
						CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
													Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
(All Compulsory)																								
1	MANAGEMENT	MAN	AEC	315301	1	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
2	EMERGING TRENDS IN ELECTRONICS	ETE	DSC	316337	-	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
3	OPTICAL NETWORK AND SATELLITE COMMUNICATION	ONS	DSC	316332	-	4	-	4	2	10	5	3	30	70	100	40	25	10	25#	10	25	10	175
4	COMPUTER NETWORK & DATA COMMUNICATION	CND	DSC	316338	-	4	-	4	2	10	5	3	30	70	100	40	25	10	-	-	25	10	150
5	CAPSTONE PROJECT	CPE	INP	316004	-	-	-	2	2	4	2	-	-	-	-	-	50	20	50#	20	50	20	150
other (Any - One)																								
6	AUTOMATION & PLC	ATP	DSE	316334	-	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
	DRONE TECHNOLOGY	DRT	DSE	316335	2	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
	VLSI APPLICATIONS	VLS	DSE	316340	-	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
Total					**3**	**18**		**12**	**10**		**20**		**150**	**350**	**500**		**125**		**100**		**175**		**900**

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment,SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends : @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :
1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

Course Category : Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)

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VLSI APPLICATIONS **Course Code : 316340**

Programme Name/s	**: Automation and Robotics/ Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics**
Programme Code	**: AO/ DE/ EJ/ ET/ EX/ IE**
Semester	**: Sixth**
Course Title	**: VLSI APPLICATIONS**
Course Code	**: 316340**

I. RATIONALE

VLSI (Very-Large-Scale Integration) design equips aspiring engineers with hands-on experience in both front-end and back-end processes. As a rapidly evolving technology in the industry, VLSI offers vast opportunities for innovation. This course provides students with fundamental skills to develop applications in VLSI using VHDL programming. Additionally, it enables them to utilize FPGA and ASIC chips for design and implement various applications.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attend following industry/employer excepted outcome through various teaching learning experiences: Develop VLSI-based electronic circuit/component using VHDL.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret CMOS technology circuits and its applications.
- CO2 - Develop digital circuits on CPLD and FPGA devices.
- CO3 - Use VHDL to develop and test digital circuits.
- CO4 - Develop VHDL program for given application.
- CO5 - Interpret VHDL simulation and synthesis.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316340	VLSI APPLICATIONS	VLS	DSE	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

VLSI APPLICATIONS **Course Code : 316340**

Total IKS Hrs for Sem. : Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
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2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe working of MOS transistor as a switch. TLO 1.2 Sketch the given gates using CMOS logic circuits. TLO 1.3 Explain stepwise process of CMOS fabrication. TLO 1.4 Differentiate between the nwell and pwell CMOS. TLO 1.5 Define the given specification/characteristics of CMOS logic family.	**Unit - I Introduction to CMOS Technology** 1.1 MOS Transistor: symbol, characteristics and operation, switch level modes connection, behavior of series & parallel MOS transistor switch, transmission gates and tristate logic 1.2 CMOS fabrication process: Wafer processing, oxidation, epitaxy deposition, ion-implementation, diffusion, metallization, packaging 1.3 Types of CMOS fabrication: nwell, pwell, twin tub process 1.4 Specifications of CMOS logic family: metastability, noise margins, power dissipation, fan-out, skew, figure of merits (Definitions only) and the parameter values 1.5 CMOS circuits for Boolean function	Lecture Using Chalk-Board Presentations Educational Video
2	TLO 2.1 Differentiate between Asynchronous and synchronous logic circuits with the help of suitable examples. TLO 2.2 Explain the Moore and Mealy machine design method with the help of suitable diagram and example. TLO 2.3 Describe the functions of each block of the given type of CPLD, FPGA, ASIC IC. TLO 2.4 Interpret FPGA, CPLA and ASIC parameters.	**Unit - II Advance Programmable Digital Devices (CPLD, FPGA, ASIC)** 2.1 Review of Sequential Logic circuits, comparison of Asynchronous and Synchronous 2.2 Moore and Mealy machine: block diagram, design examples on Moore and Mealy such as counter, sequence detector only 2.3 CPLD: concept, architecture, internal block diagram, applications 2.4 FPGA: concept, block diagram, architecture, applications. differentiate between FPGA and CPLD 2.5 ASIC: concept and design flow	Lecture Using Chalk-Board Presentations Flipped Classroom

VLSI APPLICATIONS **Course Code : 316340**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Differentiate between VHDL and Verilog on the given parameters. TLO 3.2 Optimize VHDL programming steps with its syntax. TLO 3.3 Use basic elements of VHDL programming and develop the simple code for the given function. TLO 3.4 Describe various data types used in VHDL programming with examples. TLO 3.5 Use VHDL operators to develop mathematical expressions.	**Unit - III Introduction to VLSI Design Concepts** 3.1 Hardware Description Languages (HDL): Very High-Speed HDL(VHDL) vs Verilog, and their functionality and comparison 3.2 VHDL: Features, structure and elements of VHDL (entity, architecture, configuration, package, library only definitions) 3.3 Basic Language Elements: Identifiers, VHDL objects: signal, variables and constant (syntax and use) 3.4 VHDL data types: scalar, array, composite, enumerated 3.5 VHDL operators: relational, arithmetic, logical and shift	Lecture Using Chalk-Board Educational Video Presentations
4	TLO 4.1 Compare the VHDL modelling style. TLO 4.2 Develop VHDL program using concurrent statement for the given application. TLO 4.3 Develop VHDL program using sequential statement for given application. TLO 4.4 Implement given combinational and sequential logic circuits using VHDL. TLO 4.5 Develop VHDL test bench code for the given circuit.	**Unit - IV VHDL Programming** 4.1 VHDL Modeling: data flow, behavioral, structural 4.2 Concurrent constructs (when, with) 4.3 Sequential constructs (process, if, case, loop, assert, wait) 4.4 VHDL code for combinational circuits – Logic gates, adder, subtractor, multiplexer, demultiplexer, encoder, decoder, comparator, 4-bit ALU 4.5 VHDL code for Sequential circuits – D, T and JK flip-flop, 4 bit up/down counter, MOD counter, shift registers (4-bit SISO and PIPO) 4.6 Test bench: simple test bench for a combinational circuit (full adder) and sequential logic circuit (D/T flipflop)	Lecture Using Chalk-Board Educational Video Collaborative learning
5	TLO 5.1 Describe the features of the given type of simulator with a suitable example. TLO 5.2 Define the given component in HDL simulation process. TLO 5.3 Prepare flowchart for the HDL design synthesis process. TLO 5.4 Summarize stepwise HDL design flow.	**Unit - V HDL Simulation and Synthesis** 5.1 Types of simulators: event based and cycle based 5.2 Components: Event scheduling, sensitivity list, zero modelling, simulation cycle 5.3 HDL synthesis process: Boolean optimization, flattering, factoring, mapping to gates 5.4 HDL Design flow: RTL simulation, gate-level verification, place and route	Lecture Using Chalk-Board Flipped Classroom Educational Video

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify various blocks of FPGA and CPLD. LLO 1.2 Test the functionality of various pins of FPGA and CPLD.	1	*Identification of internal block and pin configuration of FPGA & CPLD	2	CO2

VLSI APPLICATIONS **Course Code : 316340**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Install relevant EDA (such as Xilinx software) tool for VHDL. LLO 2.2 Check the VHDL libraries installed in VHDL environment.	2	*Installation of EDA tool and the relevant libraries for VLSI code development	2	CO3
LLO 3.1 Test the functionality of basic logic gates using VHDL Data flow model. LLO 3.2 Test the functionality of universal logic gates using VHDL Data flow model.	3	*Develop VHDL code for basic and universal gate for data flow model	2	CO3
LLO 4.1 Test the functionality of basic logic gates using VHDL behavioral model. LLO 4.2 Test the functionality of universal logic gate using VHDL behavioral model.	4	Develop VHDL code for basic and universal gate for behavioral model	2	CO3
LLO 5.1 Test the functionality of half and full adder using VHDL code. LLO 5.2 Test the simulated Test bench waveform.	5	*Realize the half and full Adder on FPGA board	2	CO3
LLO 6.1 Test the functionality of 4:1 multiplexer using VHDL code.	6	*Realize the Multiplexer on FPGA board	2	CO3
LLO 7.1 Test the functionality of 1:8 De-multiplexer using VHDL code.	7	Realize the De-multiplexer on FPGA board	2	CO3
LLO 8.1 Interpret the output of 4:2 encoder using VHDL code.	8	Design 4:2 encoder on FPGA board	2	CO3
LLO 9.1 Interpret the output of 3:8 decoder using VHDL code.	9	Design 3:8 decoder on FPGA board	2	CO3
LLO 10.1 Test the functionality of D flipflop using VHDL code. LLO 10.2 Test the functionality of T flipflop using VHDL code.	10	*Realize the D and T flipflop on FPGA board	2	CO3
LLO 11.1 Test the functionality of 2-bit comparator using VHDL code.	11	Design Comparator on FPGA board	2	CO3
LLO 12.1 Interpret the output of Mod-10 Up counter using VHDL code.	12	Design Up Counter on FPGA board	2	CO3
LLO 13.1 Develop VHDL code for 4-bit Up/Down Synchronous counter and test the circuit on FPGA board..	13	Design Synchronous counter on FPGA board	2	CO3
LLO 14.1 Test the functionality of 4-bit binary to gray code converter & Synthesize using FPGA.	14	Design binary to gray code converter circuit using FPGA board	2	CO3
LLO 15.1 Develop VHDL code for 8-bit Digital to analog converter (DAC) & test the circuit on FPGA board	15	*Design digital to analog converter (DAC) using FPGA board	2	CO4
LLO 16.1 Optimize the VHDL code to rotate stepper motor in clockwise direction.	16	*Design stepper motor Controller using FPGA board	2	CO5
LLO 17.1 Develop VHDL code for 4-bit ALU and simulate it using FPGA.	17	Design of 4-bit ALU/ sequence detector using FPGA board	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

VLSI APPLICATIONS **Course Code : 316340**

Assignment

- Develop the flowchart for simulation used in VHDL.
- Write syntax for concurrent and sequential statements.
- Write test bench code of universal shift register using VHDL.
- Describe architecture of CPLD/FPGA with function of each block.
- Develop flow chart of CMOS IC fabrication in p-well and n-well process.

Micro project

- Build a small ASIC system for your Home /Community.
- Develop four-bit addition/subtraction circuit using VHDL code.
- Develop square wave generator system of frequency = 1 Hz/100Hz
- Develop a VLSI based alarm system when a customer enters into the shop through exits door.
- Build a VLSI based system for vehicle security system.
- Design traffic light system using CPLD/FPGA.
- Design Lift controller system using CPLD/FPGA.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	VLSI trainer kit along with DAC/ADC trainer kit.	15
2	VLSI trainer kit along with stepper motor.	16
3	FPGA trainer kit with Accessories	2,4,5,6,7,8,9,10,11,12,13,14,15,16,17
4	JTAG cable, DMM, Bread board.	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17
5	VLSI trainer kit with accessories such as switches,LED,seven segment display etc.	4,5,6,7,8,9,10,11,12,13,14,15
6	Personal computer with latest configuration.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to CMOS Technology	CO1	12	2	4	8	14
2	II	Advance Programmable Digital Devices (CPLD, FPGA, ASIC)	CO2	10	2	2	6	10
3	III	Introduction to VLSI Design Concepts	CO3	14	4	4	8	16
4	IV	VHDL Programming	CO4	16	4	6	10	20
5	V	HDL Simulation and Synthesis	CO5	8	2	2	6	10
Grand Total				**60**	**14**	**18**	**38**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

VLSI APPLICATIONS **Course Code : 316340**

Formative assessment (Assessment for Learning)

- Two offline unit test of 30 marks and average of two-unit test will considered for out of 30 marks.
- For formative assessment of laboratory learning 25 marks.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks.
- End semester summative assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	1	1	1	1	2			
CO2	3	2	1	1	1	1	2			
CO3	3	2	2	2	2	2	3			
CO4	3	3	3	3	2	2	3			
CO5	3	3	3	2	2	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Gaganpreet Kaur	VHDL Basics to programming	Pearson Education India, 2011 ISBN: 9788131732113
2	John M. Yarbrough	Digital Logic: Application and Design	C.L Engineering, ISBN: 978 034066756
3	Willian I. Fletcher	An Engineering approach to digital design	Prentice- Hall of India ISBN: 9780132776998
4	Douglas Perry	VHDL programming by example	Tata McGraw-Hill ISBN: 9780070499447
5	Eugene D. Fabricius	Introduction to VLSI Design	McGraw Hill ISBN:9780070199484
6	Sarkar & Sarkar	VLSI design and EDA tools	Scitech Publications (lndia) Pvt Ltd ISBN: 9788183714976

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://docs.amd.com/v/u/en-US/ug1655-ise-documentation	ISE documentation for version 14.7
2	https://web.eecs.utk.edu/~dbouldin/protected/xilinx-ise-quick-start.pdf	ISE quick start tutorial
3	https://www.allaboutelectronics.org/cmos-logic-gates-explained/	Logic gates implementation using CMOS inverter

VLSI APPLICATIONS **Course Code : 316340**

Sr.No	Link / Portal	Description
4	https://www.geeksforgeeks.org/vhdl-very-high-speed-integrated-circuit-hardware-description-language/	VHDL programming.
5	https://nptel.ac.in/courses/117106092	NPTEL- VLSI Design Course

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**

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EMERGING TRENDS IN ELECTRONICS **Course Code : 316337**

Programme Name/s	**: Automation and Robotics/ Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Electronics & Computer Engg.**
Programme Code	**: AO/ DE/ EJ/ ET/ EX/ IE/ TE**
Semester	**: Sixth**
Course Title	**: EMERGING TRENDS IN ELECTRONICS**
Course Code	**: 316337**

I. RATIONALE

The rapid advancement in electronics is driven by innovations in computing, communication, automation ,technologies such as AI, ML, IoT, quantum computing. Modern manufacturing techniques, including surface mount technology and automated assembly improves production quality and sustainability. Next-generation telecom networks enable faster and more reliable data exchange. This course will help student to acquire knowledge in Emerging trends in electronics.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to attain the following industry/employer expected outcome through various teaching learning experiences: "Acquire knowledge of Emerging Trends in Electronics fields."

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Select the appropriate processor for a specific type of application.
- CO2 - Suggest the relevant techniques in the electronic system manufacturing process.
- CO3 - Suggest a different telecom network for the given application.
- CO4 - Connect IoT Devices to cloud platforms for data storage and analysis.
- CO5 - Interpret drone component functions, government guidelines, and application areas.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316337	EMERGING TRENDS IN ELECTRONICS	ETE	DSC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125

EMERGING TRENDS IN ELECTRONICS **Course Code : 316337**

Total IKS Hrs for Sem. : Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
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V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the architecture of given specific modern processors. TLO 1.2 Compare the salient features of ESP32 and ESP8266. TLO 1.3 Establish the relationship between Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL). TLO 1.4 Differentiate between Single Agent and Multi-Agent with examples. TLO 1.5 Compare classical computing with quantum computing with a suitable example.	**Unit - I Advanced Processors and Technology** 1.1 Graphical Processing Unit (GPU): Introduction, features, Overview of processor architecture, superscalar concept, advantages and applications 1.2 ESP 32: features, pin out, Interfacing board, Comparison with ESP 8266 and Arduino Uno, simple programs and applications 1.3 Artificial Intelligence/Machine Learning [AI/ML]: Definitions, applications and advantages of AI, Definition and Types of ML(Machine Learning) such as Supervised, Unsupervised and Reinforcement. Relationship between DL (Deep Learning), ML and AI. Agents in AI: Single Agent and Multi-Agent 1.4 Quantum Computing: Introduction, qubit (quantum bit), comparison of classical versus Quantum systems, Applications of Quantum Computing	Video Demonstrations Presentations Collaborative learning Flipped Classroom

EMERGING TRENDS IN ELECTRONICS **Course Code : 316337**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Compare SMD technology over traditional (through-hole components) technology in terms of size, performance, and manufacturing efficiency. TLO 2.2 Explain the Human-Machine Interface (HMI) concept in smart manufacturing. TLO 2.3 Analyze the role of robotics in smart manufacturing. TLO 2.4 Suggest modern machines of the given specifications for electronic system assembly and manufacturing. TLO 2.5 Evaluate the significance of environmental standards such as EPEAT and RoHS in electronic manufacturing and their impact on sustainability. TLO 2.6 Explain the concept of Open Source Assembly and Testing.	**Unit - II Smart Manufacturing Processes and Tools** 2.1 Surface Mount Technology (SMT): Introduction, characteristics, advantages, applications 2.2 HMI and Robotics in Smart Manufacturing Process : Introduction, functionality, types, benefits, Robotics in Smart Manufacturing: Functionality, benefits, types of Robots: Articulated Robots, Selective Compliance Articulated Robot Arm (SCARA),Autonomous Mobile Robots (AMRs), Cobots. 2.3 Modern Electronic Assembly and Manufacturing Process: Introduction, classification of machines used in electronic assembly, role, features, and specifications of different machines. Pick-and-Place Machine: Working principle and operation, specifications, Automatic Component Insertion Machine: Functionality and working mechanism, advantages over manual component placement. Reflow soldering Method :Overview of soldering techniques in PCB assembly, working principle, stages of the reflow soldering process (Preheating, Soaking, Reflow, Cooling) 2.4 Environmental standards for electronic manufacturing such as: Electronic Product Environmental Assessment Tool (EPEAT) and Restriction of Hazardous Substances (RoHS) standards 2.5 Introduction to Open Source Assembly and Testing (OSAT)	Video Demonstrations Presentations Site/Industry Visit Flipped Classroom
3	TLO 3.1 Explain the function of the given network component. TLO 3.2 Interpret the spectrum used in the present Telecom sector. TLO 3.3 Compare the mobile generations. TLO 3.4 Explain the Multi Protocol Label Switching in NGN core. TLO 3.5 Analyze Fiber to the Home (FTTH) technology, its architecture, and components of Optical Line Termination (OLT) and Optical Network Unit (ONU). TLO 3.6 Assess the effect of Optical Transport Network(OTN) on data transmission.	**Unit - III Next Generation Telecom Network** 3.1 NGN architecture: Features, Functional block diagram, Network components: Media Gateway, Media Gateway Controller, and Application Server 3.2 NGN Wireless Technology: Telecom network Spectrum: Licensed and unlicensed radio bands, Mobile network evolution (3G to 5.5G) and comparative features 3.3 NGN Core: Concepts, features and advantages 3.4 Fiber to the Home (FTTH): Features, architecture and components: Optical Line Termination (OLT) ,Optical Network Unit (ONU) 3.5 Synchronous Digital Hierarchy (SDH), Optical Transport Network(OTN): Introduction, features and applications	Lecture Using Chalk-Board Presentations Video Demonstrations Site/Industry Visit Flipped Classroom

EMERGING TRENDS IN ELECTRONICS **Course Code : 316337**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Describe different IoT architectures and their role in data processing. TLO 4.2 Compare different cloud service providers based on their capabilities and applications. TLO 4.3 Explain how IoT enhances efficiency and automation in different industrial sectors. TLO 4.4 Explain the applications and benefits of Industry 5.0 in smart manufacturing. TLO 4.5 Differentiate between Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR), along with their applications across various domains.	**Unit - IV IIoT and Immersive Technologies** 4.1 Internet of Things (IoT): Introduction, functions of Cyber physical system components, architectures, IoT sensor to cloud data routes 4.2 Introduction to Cloud computing, Cloud service providers (AWS, AZURE, GOOGLE Cloud, ThingSpeak), ThingSpeak: Features, collecting and retrieving data from ThingSpeak, applications 4.3 Applications of IoT in Industries: Automotive, Discrete Manufacturing, Telecom and Agro- industries 4.4 Industry 5.0 and Industrial IoT (IIoT): Introduction, evolution from I1.0 to I5.0, applications and benefits of I5.0, Compare I3.0, I4.0 and I5.0, Architecture of I5.0 4.5 Introduction to Immersive Technologies: Overview of Virtual reality (VR), Augmented Reality (AR), Mixed reality (MR) and Extended reality (XR)	Lecture Using Chalk-Board Hands-on Collaborative learning Flipped Classroom
5	TLO 5.1 Classify drones based on structural configuration. TLO 5.2 Describe the functions of different drone components. TLO 5.3 Interpret relevant government drone regulations. TLO 5.4 Identify the utility of drones in the given application.	**Unit - V Drone Systems and Applications** 5.1 Overview of Drone Technologies, Types of Drones: Multi-Rotor, Single-Rotor, Fixed-Wing, Hybrid 5.2 Hardware Components of drones: Frame, Propellers, Motors, Electronic speed controller, Flight controllers, Gimbal, Radio transmitter and receiver, GPS, Camera, Power distribution panel, Landing gears, Sensors: accelerometer, gyroscope and magnetometers, Batteries: lithium polymer and lithium-ion 5.3 Regulations and safety considerations: Category of zones: Red zone, Inner yellow zone, Outer yellow zone, Green zone, DGCA rules and regulations for registration, operation and pilot license of drones 5.4 Drone Applications: Photography, Logistics, Medical, Agriculture, Defence, Surveillance, Disaster management	Presentations Video Demonstrations Model Demonstration Flipped Classroom

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Develop a simple ESP32-based sensor data logging system and explain the interfacing process.
- Implement a basic IoT-based LED control program using ESP32 and document the code.
- Develop a smart home automation system using an ESP32 microcontroller, allowing users to control home appliances (lights, fans, etc.) via a smartphone using Wi-Fi and a web-based dashboard or mobile app.

- Collect temperature and humidity data using DHT11/DHT22 sensors and send it to an IoT platform like ThingSpeak.
- Use networking tools like Cisco Packet Tracer to simulate MPLS functionality.
- Detect gas leaks using an MQ-6 sensor and send alerts to users via SMS or an IoT platform.
- Use an ultrasonic sensor in dustbins to detect the garbage level and send notifications to the waste collection department.
- Assemble a simple quadcopter using a frame, motors, electronic speed controllers, and a flight controller.

Student Activity

- Prepare a report on Open Source Assembly and Testing (OSAT).
- Prepare a report on automatic electronic components assembly machine.
- Prepare a PowerPoint presentation on upcoming 5G technology.
- Prepare a report on quantum bits (qubits) and their role in quantum processing using diagrams.
- Prepare a PowerPoint presentation on various Government of India schemes related to drones.
- Prepare a report on the application area of different types of drones.
- Prepare a report on the eligibility criteria for Remote Pilot License and the DGCA approved Remote Pilot Training Organizations near your area.
- Create a PowerPoint presentation on GPU architecture and its role in AI and gaming applications.
- Prepare a PowerPoint presentation on the functions of various sensors and actuators used in drones.
- Prepare internet-based reports on real-world applications of AI and ML in different industries.

Assignment

- Compare the working of superscalar processors with real-world examples.
- Explore anti-drone technology.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED : NOT APPLICABLE

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Advanced Processors and Technology	CO1	10	2	6	8	16
2	II	Smart Manufacturing Processes and Tools	CO2	9	4	4	6	14
3	III	Next Generation Telecom Network	CO3	9	4	4	6	14
4	IV	IIoT and Immersive Technologies	CO4	8	2	4	6	12
5	V	Drone Systems and Applications	CO5	9	4	4	6	14
Grand Total				**45**	**16**	**22**	**32**	**70**

EMERGING TRENDS IN ELECTRONICS **Course Code : 316337**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests (MCQs) of 30 marks will be conducted and average of two-unit tests considered. Formative assessment of self learning of 25 marks should be assessed based on self learning activity such as Microproject/assignment/activities. (60 % weightage to process and 40 % to product)

Summative Assessment (Assessment of Learning)

- Online MCQ type Exam

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	1	2	3	3	2	3			
CO2	2	1	2	2	2	1	2			
CO3	2	1	2	2	3	1	2			
CO4	2	2	2	3	2	2	3			
CO5	1	1	2	2	2	1	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Sudhir Warier	The ABC of Fiber Optics Communication	Artech House Publishers ISBN: 978-1630814144
2	David Hanes, Salgueiro Gonzalo, et al.	IoT Fundamentals: Networking Technologies, Protocols and use cases for Internet of Things	Pearson Education ISBN: 978-9386873743
3	Saroj Kaushik	Artificial Intelligence	Cengage Learning India Pvt. Ltd. ISBN: 978-9355730428
4	Dharna Nar, Radhika Kotecha	Drone Technology for Beginners- Learn | Build | Fly Drones	Drone School India and Ane Books Pvt Ltd. ISBN: 978-8197222184
5	Garvit Pandya	Basics of Unmanned Aerial Vehicles : Time to start working on Drone Technology	Notion Press Media Pvt Ltd. ISBN: 978-1637453865
6	Bhushan Patil, Manisha Vohra	Introduction to Extended Reality (XR) Technologies	John Wiley & Sons Inc. ISBN: 978-1119857228
7	Guy A. Boy	The Handbook of Human-Machine Interaction A Human-Centered Design Approach	CRC Press ISBN: 9780367111939

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Sr.No	Author	Title	Publisher with ISBN Number
8	S K. Saha	Introduction to Robotics	Tata McGraw-Hill Education ISBN: 978-9355326461

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.rohsguide.com/rohs-faq.htm	RoHS Guide
2	http://www.trai.gov.in/	TRAI official website for Next Generation Network
3	https://www.tec.gov.in/	Technical Enginnering Centre Technical Reports.
4	https://cfdflowengineering.com/working-principle-and-compone nts-of-drone/	Introduction about drone components
5	https://www.twi-global.com/technical-knowledge/faqs/industry -5-0	Industry 5.0
6	https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-Y.20 12-200609-S!!PDF-E&type=items	Next Generation Networks – Frameworks and functional architecture mode
7	https://www.dgca.gov.in/digigov-portal/?page=jsp/dgca/Invent oryList/headerblock/drones/RPAS.html	DGCA Drone rules
8	https://circuitdigest.com/microcontroller-projects/programmi ng-esp32-with-arduino-ide	Programming ESP32 Board with Arduino IDE
9	https://cloud.google.com/learn/artificial-intelligence-vs-machine-learning	Artificial intelligence (AI) vs. machine learning (ML)
10	https://www.plugxr.com/augmented-reality/ar-vr-mr-xr/	AR vs VR vs MR vs XR – What is the difference?
11	https://www.electronicsandyou.com/electronics-assembly-equip ment-guide.html	Electronic system assembly and machines
12	https://esp32io.com/	ESP 32 Tutorials
13	https://randomnerdtutorials.com/getting-started-with-esp32/	Getting Started with the ESP32 Development Board
14	https://learnesp32.com/videos/course-introduction/course-int roduction	Learn ESP32

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

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OPTICAL NETWORK AND SATELLITE COMMUNICATION **Course Code : 316332**

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Electronics & Computer Engg.**
Programme Code	**: DE/ EJ/ EK/ ET/ EX/ IE/ TE**
Semester	**: Sixth**
Course Title	**: OPTICAL NETWORK AND SATELLITE COMMUNICATION**
Course Code	**: 316332**

I. RATIONALE

Optical networks and satellite communication are the backbone of all high speed communications. The optical networking and satellite communication course is crucial for driving innovative technologies across multiple sectors. This course has been designed to empower diploma engineering students to maintain fiber optics and satellite communication systems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attend the following industry/employer expected outcome through various teaching learning experiences.

Maintain optical and satellite communication systems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret the functions of the various units of optical fiber communication system.
- CO2 - Evaluate the performance characteristics of optical sources and detectors.
- CO3 - Establish analog and digital fiber optic link.
- CO4 - Analyze various parameters influencing performance of transmitted and received signals in satellite communication systems.
- CO5 - Maintain Satellite earth segment.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316332	OPTICAL NETWORK AND SATELLITE COMMUNICATION	ONS	DSC	4	-	4	2	10	5	3	30	70	100	40	25	10	25#	10	25	10	175

OPTICAL NETWORK AND SATELLITE COMMUNICATION **Course Code : 316332**

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Interpret the Electromagnetic Magnetic Spectrum and spot the optical bands used for optical fiber communication. TLO 1.2 Describe the functions of each block in fiber optic communication system. TLO 1.3 Define the given basic optic terms. TLO 1.4 Classify the optical fiber cables based on modes of propagation of light and index profile TLO 1.5 Describe fiber joints, fiber connectors and splices. TLO 1.6 Describe step by step splicing procedure.	**Unit - I Basics of Optical fiber communication** 1.1 Electromagnetic spectrum, optical bands and optical windows, need for optical fiber communication. 1.2 Construction, advantages ,disadvantages and applications of fiber optic cable ,block diagram of optical fiber communication system. 1.3 Definition-Reflection, Refraction, Total Internal Reflection (TIR),Snell's law, Critical angle, Numerical Aperture (NA) , Acceptance angle and Acceptance cone , Light propagation in optical fiber–(Numerical on above concepts) 1.4 Classification of optical fibers-based on modes of propagation of light and index profile, Propagation modes-single mode, multi mode ,mode-field diameter in single-mode optical fiber (SMF) 1.5 Fiber joints, fiber connectors, splices 1.6 Splicing Techniques-Fusion splice,V-groove splice and elastic tube splice	Presentations Video Demonstrations Lecture Using Chalk-Board

OPTICAL NETWORK AND SATELLITE COMMUNICATION **Course Code : 316332**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Describe working principle and characteristics of given optical source. TLO 2.2 Describe the working principle and characteristics of the given optical detector. TLO 2.3 Explain the coherent detection technique used in optical receivers. TLO 2.4 Describe the working of the given optical network component. TLO 2.5 Compare the working of optical amplifiers.	**Unit - II Optical Communication Systems** 2.1 Working principle and characteristics of sources: Edge emitting Light Emitting Diode, Edge emitting Light Amplification by Stimulated Emission of Radiation 2.2 Working principle and characteristics of detectors : PIN photodiode , Avalanche photo diode, Comparison of PIN photodiode and Avalanche photo diode 2.3 Eye diagram, BER ,Q -Factor and Coherent detection in optical receivers 2.4 Couplers, isolators, circulators, Optical routers 2.5 Basic applications and types of optical amplifiers: Erbium -Doped Fiber Amplifiers, Raman Amplifiers, features of Optical network Ethernet standards : IEEE 802.3j,802.3y,802.3z	Lecture Using Chalk-Board Presentations
3	TLO 3.1 Explain dispersion in optical fibers. TLO 3.2 Describe dispersion management and compensation techniques for improved transmission. TLO 3.3 Illustrate the effect of pulse spreading on signal transmission. TLO 3.4 Describe the transmission losses in the optical fiber cable. TLO 3.5 Describe the steps to measure optical parameters using OTDR. No Numerical.	**Unit - III Characteristics of Optical Fiber** 3.1 Dispersion in Optical fiber, types of dispersion 3.2 Dispersion compensation techniques , dispersion measurements - Chromatic Dispersion, Group Velocity Dispersion, Dispersion Slope, Polarization Mode Dispersion 3.3 Pulse spreading and its impact on signal transmission 3.4 Transmission losses in the optical fiber- Insertion loss, Return loss, dispersion loss, coupling loss, attenuation loss, absorption losses, radiation losses and linear scattering losses 3.5 Link power budget, Optical Time Domain Reflectometer (OTDR)-Working Principle.	Lecture Using Chalk-Board Demonstration Presentations
4	TLO 4.1 Describe the types of satellites and their respective functions. TLO 4.2 Explain the phenomenon of limits of visibility and Sun Transit Outage. TLO 4.3 Define the given key satellite communication terms-(latitude, longitude, look angle, elevation angle, station keeping, propagation delay, velocity, and footprint). TLO 4.4 Describe Kepler's law of satellite motion.	**Unit - IV Overview of Satellite Systems** 4.1 Block diagram of Satellite Communication system, Earth segment , Different types of satellites-Active, Passive, geostationary and geosynchronous, Frequency allocation for satellite services-uplink and downlink frequency, Satellite frequency bands 4.2 Different satellite orbits-Low Earth Orbit (LEO), Medium Earth Orbit (MEO), Elliptical Orbit, Geostationary Earth Orbit (GEO) and their comparison , limits of visibility and Sun Transit Outage. 4.3 Basic terminologies used in satellite communication-latitude, longitude ,look angle, elevation angle, station keeping, propagation delay time, velocity and footprint (numerical on Look Angle) 4.4 Kepler's law of satellite motion (three laws), apogee and perigee heights, orbital perturbations, effects of a nonspherical earth shape, atmospheric drag, effect of eclipse on satellite motion.	Lecture Using Chalk-Board Video Demonstrations Flipped Classroom Presentations Hands-on Case Study Site/Industry Visit

OPTICAL NETWORK AND SATELLITE COMMUNICATION **Course Code : 316332**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Explain the roles and operations of the subsystem in the satellite earth station. TLO 5.2 Describe various satellite link transmission losses. TLO 5.3 Compute different parameters related to satellite communication using the link power budget analysis. TLO 5.4 Describe the working of the VSAT with the help of a suitable block diagram.	**Unit - V Satellite space segment and space link** 5.1 Block Diagram of Satellite Earth Station, Antenna subsystem,Low Noise Amplifier (LNA),Power subsystem, Telemetry Tracking and Control (TT & C) system, Power Supply subsystem, Attitude Control, Spinning satellite stabilization, Momentum wheel stabilization, Thermal control, Main and auxiliary propulsion subsystem, Transponders:-Single ,double conversion and regenerative type, wideband receiver, input demultiplexer, power amplifier 5.2 Equivalent Isotropic Radiated Power (EIRP), Transmission Losses : Free- space transmission loss, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionosphere losses, PC- PC communication using Satellite Link , rain attenuation 5.3 Link-Power Budget, System Noise, Carrier-to-Noise Ratio, Combined Uplink and Downlink C/N Ratio, Reliability in satellite System 5.4 Satellite Applications: GPS, VSAT, Meteorology applications.	Lecture Using Chalk-Board Video Demonstrations Flipped Classroom Presentations Hands-on Case Study Site/Industry Visit

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify optical components, cables.	1	* Identification of optical components and cables.	2	CO1
LLO 2.1 Identify core, cladding, and coating of optical fiber.	2	Identification of core,cladding and coating of optical fiber cable.	2	CO1
LLO 3.1 Measure numerical aperture of optical fiber to find the refractive index.	3	* Find numerical aperture of optical fiber.	2	CO1
LLO 4.1 Test the performance of an Avalanche Photodiode (APD).	4	* Test the performance of an Avalanche Photodiode (APD) (Virtual lab can be used in case of non- availability of instruments in the lab)	2	CO2
LLO 5.1 Evaluate the Performance of the given photodiode (detector) using LED as an Optical Source	5	* Analysis of Photodiode Characteristics (Virtual lab can be used in case of non-availability of instruments in the lab)	2	CO2
LLO 6.1 Test the performance of the given photo-diode (Detector) using LASER as an optical source	6	* Measurement of light intensity and photocurrent at various positions for a given photodiode	2	CO2
LLO 7.1 Measure bit error rate (BER) at the optical receiver.	7	Find the bit error rate (BER) at the optical channel receiver.	2	CO2
LLO 8.1 Measure various parameters of the observed eye pattern.	8	* Measurement of various parameters of eye pattern.	2	CO2
LLO 9.1 Measure the power and find the attenuation loss in the given length of optical fiber cable.	9	Measurement of attenuation loss in optical fiber.	2	CO3
LLO 10.1 Measure the bending loss in optical fiber.	10	* Measurement of bending loss of given optical fiber cable.	2	CO3
LLO 11.1 Measure optical power using optical meter.	11	Measurement of optical power using optical meter	1	CO3

OPTICAL NETWORK AND SATELLITE COMMUNICATION **Course Code : 316332**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 12.1 Calculate the Link Power Budget as per equation.	12	* Computation of Link Power Budget for Fiber Optics Using Coding (Use open source simulation software).	2	CO3
LLO 13.1 Determine the rise time budget.	13	* Computation of rise time budget w.r.t fiber optics through coding (Use open source simulation software).	2	CO3
LLO 14.1 Test satellite link operations.	14	* Establishing an Active satellite link and demonstrating link failure operations	2	CO4
LLO 15.1 Create a direct communication link between the Uplink Transmitter and Downlink Receiver using a tone signal .	15	Establish a direct communication link between the Uplink Transmitter and the Downlink Receiver using a tone signal.	2	CO4
LLO 16.1 Establish audio video satellite link between transmitter and receiver	16	Establishing audio video satellite link between transmitter and receiver	2	CO4
LLO 17.1 Establish a link to transmit and receive three separate signals (Audio, Video, Tone).	17	Simultaneous Transmission and Reception of Audio, Video, and Tone/Voice Signals via Satellite Link	2	CO4
LLO 18.1 Test the performance of satellite link by sending telecommand and receive the telemetry Data	18	Evaluating satellite link performance by transmitting telecommands and receiving telemetry data.	2	CO4
LLO 19.1 Interpret the result of the satellite link signal using function generator.	19	Transmission and reception of function generator waveforms through satellite communication link.	2	CO4
LLO 20.1 Estimate satellite Look Angles (Azimuth & Elevation) through coding.	20	* Calculation of Satellite Look Angles (Azimuth & Elevation) Using Coding (Use open source simulation software).	2	CO4
LLO 21.1 Verify Kepler's laws of motion	21	Simulating and validating Kepler's laws of planetary motion using code.(Use any relevant open source software).	2	CO4
LLO 22.1 Estimate Satellite Eclipse Periods	22	Simulation of Satellite Eclipse Periods through coding.(Use open source simulation software).	2	CO4
LLO 23.1 Measure carrier-to-noise ratio (C/N) of established satellite link.	23	* Measurement of the carrier-to-noise ratio (C/N) of the established satellite link.	2	CO5
LLO 24.1 Use RS 232 ports to set up a PC-PC satellite communication link	24	* Establish a direct communication link between two PCs using RS-232 serial ports.	2	CO5
LLO 25.1 Estimate rain attenuation through simulation.	25	* Find rain attenuation through coding (Use open source simulation software).	2	CO5
LLO 26.1 Investigate satellite link budget.	26	* Simulation of satellite link budget through coding (Use open source simulation software).	2	CO5
LLO 27.1 Test the reliability of satellite system.	27	Analysis of reliability in satellite system.	2	CO5
LLO 28.1 Calculate EIRP of any given satellite communication link.	28	* Find EIRP or any given satellite communication link through coding.(Use open source simulation software).	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

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VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- The orbit of an earth orbiting satellite has an eccentricity of 0.15 and a semimajor axis 9000 km, determine the apogee. [Assume the earth's radius as 6371 km].
- A fiber has a core diameter of 2 micro meter and its core refractive index is 1.43. The refractive index of cladding is 1.415. Determine : (i) numerical aperture (ii) critical angle (iii) Acceptance angle (iv) Relative refractive index difference.

Student Activities

- Prepare a survey report to compare the technical specifications of different types of optical sources and detectors.
- Prepare a report on splicing techniques used in industry or telecom service providers.
- Prepare the chart to indicate applications of various satellite frequency bands (L,S,C,X,Ku,Ka band).
- Conduct an Internet survey and prepare a detailed report on GPS and its applications.

Visit

- Visit a facility where fiber optics are utilized for communication and various applications ,such as institute LAN, computer networking, remote sensing, the automotive industry, healthcare, decorations and lighting, telecommunication, cable television, mechanical inspections and prepare a report.
- Visit a satellite center or pool lab equipped with a satellite setup and compile a detailed report on its components and their functions.

Micro project

- Build fiber optic lamp to demonstrate total internal reflection and light dispersion.
- Develop a GPS-based speedometer.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Splicing,Cutting and trimming tool of plastic fiber optics cables	1,2,9,10,11
2	Fiber optic cleaning kit	1,2,9,10,11
3	Fiber optic cables	1,2,9,10,11
4	Fiber optic Trainer kit	1,3,7,8,9,10,11
5	Optical fiber power meter	11
6	Desktop computer/Laptop,List of software:MATLAB,SCILAB or any other open source software	12,13,20,21,22,25,26,27,28
7	Spectrum Analyzer-frequency range-2.4 to 2.495 GHzResolution-26 KHz to 3 MHz,resolution BW-58.036 to 812.500 KHz	14,15,16,17,18,19,23

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
8	Satellite Trainer Kit (ST2272)/(STC 24):Uplinking frequency 2414/2432/2450/2468 MHz,4 MHz clock frequency,PIC16F84-8 bit RISC processor based PLL,16 MHz Bandwidth,FM Modulation of Audio and Video 5/5.5/8 MHz Audio and Video Modulation,Detachable Dish Antenna,Radiated Power output 25mW (approx.),4 downlink frequencies 2414/2432/2450/2468 MHz	14,15,16,17,18,19,23
9	RF Signal Generator,9 KHz to 3 GHz,Output Power @ 1 GHz,-127 dBm to +13 dBm AM,FM,PM Analog I/Q Input Pulse,Frequency Modulation-Maximum Deviation @ 1 GHz,20 Hz to 100 KHz	19
10	PC-Processor-dual core @ 2.4 GHz(i5 or i7 Intel processor or equivalent AMD),RAM-4GB,Hard Drive-320 GB 5400 RPM hard drive,OS-win 7/10	24
11	DMM:DC,0-1.5/3 Amp,0-2.5/5 Amp,0-5/10 Amp,0-150/300V,0-250/500V,0-75/150VAC-0-1000V,0-10A	4,5,6
12	Fiber optic cable Tester	4,5,6
13	Lux meter:Display:3 1/2 digit 18mm (0.7")/LCDRanges:1 to 50,000 LUX/Over -input:indication of	4,5,6
14	Power Supply Type:DC,0-30 V, 0-3 A	4,5,6,9,10,11
15	OTDR-Attenuation resolution -0.001BdB,Attenuation measurement linearity 0.05 dB ,Distance measurement accuracy +/- (0.5 + resolution + 5 X 10-5 X L) m	9
16	CRO/Digital storage oscilloscope:60 MHz/100 MHz/200 MHz bandwidth,500MS/s to 1 GS/s real -time sample rate,50 GS/s sample rate for repetative waveforms,High resolution color LCD display	9,10

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of Optical fiber communication	CO1	10	2	4	6	12
2	II	Optical Communication Systems	CO2	10	2	6	6	14
3	III	Characteristics of Optical Fiber	CO3	15	4	6	6	16
4	IV	Overview of Satellite Systems	CO4	10	2	4	6	12
5	V	Satellite space segment and space link	CO5	15	2	6	8	16
Grand Total				**60**	**12**	**26**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks and average of two unit test marks will be considered for out of 30 marks.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks. End semester summative assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

OPTICAL NETWORK AND SATELLITE COMMUNICATION **Course Code : 316332**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	2	3	2	2	3			
CO2	3	2	2	3	2	2	1			
CO3	2	1	3	2	1	2	2			
CO4	3	2	3	3	1	1	3			
CO5	1	3	2	1	2	1	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Kieser, Gerd	Fiber Optic Communication	Mc Graw Hill Higher Education, New Delhi ,2013, ISBN: 9781259006876,
2	Roddy Dennis	Satellite Communications	Tata McGraw-Hill, New Delhi, fourth edition ,2017 ISBN-13: 978-0070077850
3	G Agrwal	Fiber optic communication System	John Wiley and Sons, New York ,ISBN: 978-1-119-73736-0.
4	Biswanath Mukherjee	Optical Communication Networks	McGraw-Hill,ISBN-13. 978-0070444355
5	Katiyar,Sapna	Satellite Communication	Katson publications,3rd edition 2013,ISBN-978-93-5014-481-7
6	Rao Raja K.N.	Satellite Communication concepts and applications	PHI learning Private limited,New Delhi,second edition 2012,ISBN-978-81-203-4725-0

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=oIurmHsRFSc	NPTEL sessions IIT Mumbai
2	https://oc-iitr.vlabs.ac.in/List%20of%20experiments.html	Virtual Lab for optical communication
3	https://www.youtube.com/watch?v=ougKUUM3hJA&list=PLHj96QRJ0kOhH8xoXXrOgkMf9ZOvjhqYl	NPTEL-NOC IITM video: Fiber Optic Communication Technology
4	https://www.youtube.com/playlist?list=PLgwJf8NK-2e7CDIWsh61eItP9iRw1EIQc	Optical Fiber Communication
5	https://www.youtube.com/watch?v=tu9mW6U6Xmc	NPTEL sessions IIT Mumbai
6	https://www.youtube.com/watch?v=Lis3Bk_guEM	NPTEL sessions IIT Mumbai
7	https://www.youtube.com/playlist?list=PL3rE2jS8zxAxamj-MY7FvzOZkHUALNndQ	Satellite Communication Videos
8	https://youtu.be/n2VeCHetC0I	Simulation of Photodiode
9	https://youtu.be/dZsXqJrZDOQ?si=BWR9hNXMifA44O4r	Bending loss and attenuation loss measurement in optical communication
10	https://youtu.be/jvLmcbxouB4?si=KW-7AUH8x3y9ZZ5l	Measurement of Numerical Aperture

OPTICAL NETWORK AND SATELLITE COMMUNICATION **Course Code : 316332**

Sr.No	Link / Portal	Description
11	https://youtu.be/x0SCzP9mt3c?si=Oh0HSXikOM9GWKhl	Determination of the acceptance angle and numerical aperture of a given optical fiber
12	https://youtu.be/bMgU3N1Vuvc?si=n9tx1V8x5DyS2YQc	Measurement of attenuation loss in optical fiber
13	https://youtu.be/4MYfxlVoUoQ?si=H-dVoo9Sw9k58cMG	Measurement of bending loss in optical fiber
14	https://youtu.be/GP39QVYwmNU?si=2AnM1ieV-Dwbj7Iv	How to Read an OTDR Trace - from Corning Cable Systems
15	https://youtu.be/xba2MThR9Ls?si=fr3rgi6om8dYvoXb	Fiber Optic Splicing Guide & Demo
16	https://www.youtube.com/watch?v=oPCmLD3LQk0	Scientech 2272A Satellite Communication Trainer Kit DEMO

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**

Programme Name/s	**: Architecture Assistantship/ Architecture and Interior Design/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Fashion & Clothing Technology/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Manufacturing Technology/ Medical Electronics/ Metallurgical Engineering/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg.**
Programme Code	**: AA/ AD/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DC/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MRT/ MU/ MY/ PG/ PN/ PO/ SC/ SE/ TC/ TE**
Semester	**: Fifth / Sixth**
Course Title	**: MANAGEMENT**
Course Code	**: 315301**

I. RATIONALE

Effective management is the cornerstone of success for both organizations and individuals. It empowers diploma engineers/ professionals to accomplish their tasks with finesse and efficiency through strategic planning and thoughtful execution, projects can optimize finances, enhance safety measures, facilitate sound decision-making, foster team collaboration and cultivate a harmonious work environment. The diploma engineers require leadership and management skills with technical knowledge of the core field to carry out various tasks smoothly. This course aims to instill fundamental management techniques, empowering diploma engineers/ professionals to enhance their effectiveness in the workplace.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Apply the relevant managerial skills for achieving optimal results at workplace.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Use relevant management skills to handle work situation
- CO2 - Apply appropriate techniques of product, operations and project management
- CO3 - Use comprehensive tools of recent management practices
- CO4 - Plan suitable marketing strategy for a product / service
- CO5 - Utilize supply chain and human resource management techniques for effective management

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

MANAGEMENT **Course Code : 315301**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
315301	MANAGEMENT	MAN	AEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125

Total IKS Hrs for Sem. : 1 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Justify the importance of management thoughts in Indian knowledge system. TLO 1.2 Describe the importance of management in day to day life. TLO 1.3 Explain Henry Fayol’s principles of management. TLO 1.4 Describe the role of each level of management in its management hierarchy. TLO 1.5 Practice the self management skills for a given situation TLO 1.6 Apply the required managerial skills for a given situation	**Unit - I Introduction to Management** 1.1 Evolution of management thoughts from ancient/medieval to modern times in India (IKS) 1.2 Management: meaning, importance, characteristics, functions & challenges. 1.3 Introduction to scientific management- Taylor's & Fayol's principles of management 1.4 Levels & functions of management at supervisory level. 1.5 Self management skills: Self awareness, self discipline, self motivation, goal setting, time management, decision making, stress management, work life balance and multitasking 1.6 Overview of Managerial Skills: negotiation skills, team management, conflict resolution, feedback, leadership	Presentations Case Study Interactive session Quiz competition Mixed Picture Puzzle

MANAGEMENT **Course Code : 315301**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Identify the appropriate creativity technique for new product development TLO 2.2 Describe the new product development process for a product / service TLO 2.3 Comprehend the importance of various strategic steps Product Management TLO 2.4 Elaborate Agile product management TLO 2.5 Explain the significance of the Project Management TLO 2.6 Describe the various tools of project management	**Unit - II Product, Operations and Project Management** 2.1 Creativity and innovation management: creativity techniques - brainstorming, checklist, reverse brainstorming, morphological analysis, six thinking hats. 2.2 New product development, change management 2.3 Product Management -meaning, strategic steps for sustainable design of a product 2.4 Agile product management- concept, benefits, principles and manifesto 2.5 Project Management: importance, areas within project management,4Ps and phases 2.6 Tools of Project Management: PERT and CPM, GANTT & Chart Overview of Estimate and Budget	Presentations Case Study Video Demonstrations Presentations Role Play
3	TLO 3.1 Understand the importance of quality management tools TLO 3.2 Explain the importance of various techniques for optimization and waste minimization TLO 3.3 State the importance of ISO quality standards TLO 3.4 Describe ERP TLO 3.5 State the importance of ISO TLO 3.6 Recognize the importance of customer satisfaction as a competitive advantage	**Unit - III Management Practices** 3.1 Quality circle, kaizen, Six Sigma, TQM 3.2 5S, Kanban card system, TPM, Lean Manufacturing: Meaning, Steps and Importance 3.3 Quality Standards and ISO: Meaning, ISO 9001:2016, ISO 14000, OSHA 2020 3.4 The overview of ERP along with example 3.5 Service quality and customer/client satisfaction, servicescape	Presentation Case study Interactive session Quiz Video Demonstration Lecture Using Chalk-Board
4	TLO 4.1 Explain the importance of marketing techniques TLO 4.2 Explain the importance of needs, wants and desires in marketing TLO 4.3 Interpret the traditional and digital marketing techniques TLO 4.4 Plan different aspects of an event management	**Unit - IV Marketing Management** 4.1 Marketing management: meaning, significance, Seven P's of Marketing 4.2 Needs, wants and demands in marketing. Customer relationship management 4.3 Types of marketing: traditional and digital marketing 4.4 Event management: types, different aspects of event management, crisis management	Case Study Interactive session based video Role Play Flipped Classroom Presentations

MANAGEMENT **Course Code : 315301**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 State the importance of supply chain and logistics management TLO 5.2 Explain the components of supply chain and logistics Management TLO 5.3 Describe the role of information technology in supply chain & logistics management TLO 5.4 State the significance of Human Resource Management TLO 5.5 Analyze the various methods of recruitment, selection and training for an organization TLO 5.6 List the qualities of a successful supervisor	**Unit - V Supply Chain & Human Resource Management** 5.1 The overview of Supply Chain and logistics Management 5.2 Components of Supply Chain and logistics Management 5.3 Role of information technology in supply chain & logistics management 5.4 Overview of Human Resource Management-Meaning,significance,scope and principles 5.5 Recruitment, selection and training of human resources. Chalk Circle 5.6 Qualities of a successful supervisor /team leader and types of leadership	Presentations Video Demonstrations Case Study Collaborative learning Video Demonstrations Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment / Article

- Make a one page note based on a book of management you read.
- Write a short article on inventory management exploring online learning resources.
- Prepare a report on ISO standards applicable to your field. a. IATF 16949-2016 / SLA-TS 16949-2016, - Automotive Industry b. ISO 22000 — Food safety management c. ISO 50001 — Energy management d. ISO/IEC 27001 - Cyber Security e. ISO/DIS 4931-1 - Buildings and civil engineering works
- Prepare a 4 quadrant matrix of time management for managing the tasks.
- Prepare a report on any one software used for Supply Chain and Logistics Management.
- Prepare a GANTT Chart for project management related to your field.

Note Taking

- Watch a Tedx Talk Video on managerial skills and take notes in the form of keywords.

Case Study

- Prepare a case study and discuss the same on following topics a.Self Management Skills b.Six Thinking Hats c.Kaizen d.Quality Circle e.Safety Measures in different organizations related to your field
- Study the recruitment and selection process of any organization related to your field.
- Prepare a case study on management lessons based on life of Chhatrapati Shivaji Maharaj
- Conduct outbound training on managerial skills. Make a video and upload on social media.

Quizes

- Participate in online quizzes related to areas of management .

Assignment

- Workshops to be conducted for students on following topics a. creativity techniques b. time management c. stress management d. negotiation and conflict e. goal setting f. meditation new product development

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED : NOT APPLICABLE

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Management	CO1	13	8	6	4	18
2	II	Product, Operations and Project Management	CO2	8	2	4	6	12
3	III	Management Practices	CO3	8	4	4	6	14
4	IV	Marketing Management	CO4	8	2	4	6	12
5	V	Supply Chain & Human Resource Management	CO5	8	4	4	6	14
Grand Total				**45**	**20**	**22**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- MCQ Based Class Test, Self Learning Activities / Assignment

Summative Assessment (Assessment of Learning)

- Summative Assessment (Assessment of Learning) MCQ based

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3

MANAGEMENT **Course Code : 315301**

CO1	1	1	1	-	-	2	3			
CO2	1	3	3	-	1	3	3			
CO3	1	3	1	-	1	1	3			
CO4	1	2	2	-	1	2	3			
CO5	1	1	2	-	1	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	A. K. Gupta	Engineering Management	S. Chand, ISBN: 81-219-2812-5, 2007, 2nd Edition
2	O. P. Khanna	Industrial Engineering &management	Dhanpat Rai Publication, ISBN: 978-8189928353, 2018
3	Harold Koontz and Heinz Weinrich	Essentials of Management	Tata McGraw Hill Education ISBN: 9789353168148, 2020, 12th edition
4	E. H. McGrath	Basic Managerial Skills for All	PHI ISBN: 978-8120343146, 2011, 9th Edition
5	Andrew DuBrin	Management Concepts and Cases	Cengage Learning, ISBN: 978-8131510537, 2009, 9th edition
6	K. Dennis Chambers	How Toyota Changed the World	Jaico Books ISBN: 978-81-8495-052-6, 2009
7	Jason D. O'Grandy	How Apple changed the Wolrd	Jaico Publishing House ISBN: 978-81-8495-052-0, 2009
8	Subhash Sharma	Indian Management	New Age International Private Limited ; ISBN-978-9389802412, 2020, 1st edition
9	Chitale, Dubey	Organizational Behaviour Text and Cases	PHI LEARNING PVT. LTD., ISBN: 978-9389347067, 2019, 2nd Edition

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.debonogroup.com/services/core-programs/six-thinking-hats/	Six Thinking Hats
2	https://hbr.org/1981/09/managing-human-resources	HR Management
3	https://theproductmanager.com/topics/agile-product-management/	Agile Product Management
4	https://www.cdlogistics.ca/freight-news/the-5-components-of-supply-chain-management	Supply Chain Management
5	https://www.infosectrain.com/blog/understanding-the-concepts-of-gantt-chart-and-critical-path-methodology-cpm	PERT, CPM, GANTT Chart
6	https://www.simplilearn.com/best-management-tools-article	Management Tools
7	https://www.psychometrica.in/free-online-psychometric-tests.html	Psychometric Tests
8	https://www.investopedia.com/terms/e/erp.asp	ERP
9	https://asq.org/quality-resources/quality-management-system	QMS
10	https://testlify.com/test-library/creative-thinking/	Psychometric Tests
11	https://www.mindtools.com/	Management Skills
12	https://www.investopedia.com/terms/d/digital-marketing.asp	Digital Marketing

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MANAGEMENT **Course Code : 315301**

MSBTE Approval Dt. 24/02/2025 **Semester - 5 / 6, K Scheme**

CAPSTONE PROJECT **Course Code : 316004**

Programme Name/s	**: Automobile Engineering./ Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Manufacturing Technology/ Metallurgical Engineering/ Production Engineering/ Computer Science/ Electronics & Computer Engg.**
Programme Code	**: AE/ AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ ME/ MK/ MRT/ MY/ PG/ SE/ TE**
Semester	**: Sixth**
Course Title	**: CAPSTONE PROJECT**
Course Code	**: 316004**

I. RATIONALE

Capstone projects in engineering study are considered important as it allow students to integrate and apply the knowledge and skills acquired throughout their academic program and effectively demonstrating their learning of programme by tackling a real-world problem, ultimately keeping them well prepared for the job market. The capstone project is usually the final assignment and plays a vital role in preparing students for the world of work to its practical applications and ability to help hone students' professional knowledge and skills. Normally, capstone projects are developed in collaboration with industries or businesses, providing students with valuable insights. Capstone projects has been considered as an integral part of diploma curriculum. It helps learners to perform and demonstrate skills gained due to early courses of Diploma study independent. Therefore, this is considered as a course of final year/semester study.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Apply professional skills for solving , executing and demonstrating solutions to real-world problems

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Elaborate the identified field problem from the perspective of project work at institute.
- CO2 - Conduct feasibility & viability analysis (using data collection, experiments, Simulation , Coding) to validate required resources, cost, support of the project work.
- CO3 - Apply the acquired knowledge and skills in providing solutions to the real field/industrial problems.
- CO4 - Present Project and its output/ findings / achievements alongwith its exhibits.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

CAPSTONE PROJECT **Course Code : 316004**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316004	CAPSTONE PROJECT	CPE	INP	-	-	2	2	4	2	-	-	-	-	-	50	20	50#	20	50	20	150

V. General guidelines for PROJECT WORK

- The Project- problems must be related to the programme or may be interdisciplinary, based on the industry expected outcomes.
- The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work they would like to execute.
- Project titles are to be finalized in co-ordination/consultation with the Faculty mentor. However, faculty may form a team of students as per specific roles- Literature survey/data collection, data Analysts, model/prototype developers, testers, Project managers using IoTs ITES and software /application development. Study type project is NOT advisable.
- Project must be assigned to a group of 3-4 students under the guidance of identified faculty mentor.
- Students are required to prepare a prototype/working model/software of the Project and simultaneously prepare a report.
- Students shall Submit One Hard copy and one Soft copy each of Project Report and soft-copy of the project code or the working model.
- Students must maintain a project execution diary having the progress steps and details. The concerned faculty should check the diary on a weekly basis and accordingly interact with students based on the progress shown and keep proper record with feedback if any.
- Project shall address National Thrust area such as Environment, Digitization, Automation, sustainability and similar domains.
- Student shall try to use the national and international standards wherever possible (processes / materials / equipments etc ..)

VI. Project facilitation guidelines:

Once the Project statement has been finalized and allotted to the students, the Faculty Mentor role is very important as guide, motivator, catalyser to promote learning and sustain the interest of the students. At the same time the Faculty Mentor is not expected to guide the students on each step, otherwise it will curb the creativity of the students-group. The Faculty Mentor has to work as a mentor. Following should be kept in mind while facilitating the project at the institute:

1.Project orientation cum -briefing: the project should be relevant to the curriculum of the programme. The project shall be cost effective taking safety aspects, ethical issues, environmental issues and confidentiality as per expectation of industry(if any) into consideration, The work may be industry Sponsored.

2.Information search and data collection: the information and data should be realistic and relevant to the problem /project. Hypothetical data is not to be taken into consideration.

3.Implementation and Monitoring: The project must have important steps /milestones to achieve as per the time frame/action plan prepared by students and faculty. The monitoring mechanism such as daily/weekly dairy (**Format given below)** must be clearly explained and delineated for the students.

VII.Criteria of Assessment /Evaluation of Project work

A. Formative Assessment (FA) criteria

The **Formative Assessment** (FA) of the students for 50 marks is to be done based on following criteria.

Appropriate RUBRICS may be used for assessment

Rubrics for Assessment of the team

Sr.No.	Criteria	Marks
1	Project Selection & Problem definition	05
2	Literature survey and data collection/ Gathering	05
3	Design / concept of project/ Working - Execution of Project	10
4	Stage wise progress as per Action plan/milestone	05
5	Quality Report Writing	05

Rubrics for Individual Assessment

Sr.No.	Criteria	Marks
1	Contribution as a team member	05
2	Depth of Knowledge	10
3	Presentation	05

B. Summative Assessment Criteria

- The summative assessment for 50 marks is to be done and based on following criteria. This assessment shall be done by the faculty mentor and External examiner.

Sr.No.	Criteria	Marks
1	Capstone Project Completion as per plan	10
2	Project related Requirement Analysis & Designing	10
3	Developing a Solution with proper justifications, Teamwork	10
4	Project Report Writing	10
5	Project Presentation	10

(**NOTE :** Team based and Individual performance based summative assessment may include Innovativeness , Technology used , user friendliness , cost effectiveness , society benefits etc..)

SUGGESTED RUBRIC FOR SUMMATIVE ASSESSMENT OF CAPSTONE PROJECT

PROJECT ASSESSMENT				
Project Title:				
Project Assessment Rubric				
Performance	**Excellent**	**Good**	**Fair**	**Poor**
Criteria	**9-10 marks.**	**6-8 marks.**	**4-5 marks.**	**0-3 marks**
Capstone Project Completion	Excellent **The project is completed as per tasks described in synopsis.**	Good **The project is completed but require minor modifications.**	Fair **The project is completed but require several modifications.**	Poor **The project is not completed as per tasks described in synopsis.**

CAPSTONE PROJECT **Course Code : 316004**

	9-10 marks.	**6-8 marks.**	**4-5 marks.**	**0-3 marks**
Project related Requirement Analysis & Designing	**Effectively contributed in requirement analysis and designing.**	**Partially Contributed in requirement analysis and designing.**	**Attempted to contribute in requirement analysis and designing**	**No contribution in requirement analysis and designing.**
	9-10 marks.	**6-8 marks.**	**4-5 marks.**	**0-3 marks**
Developing a Solution with proper justifications , Teamwork	**Developed the critical solution modules with Innovation, optimized design and worked very well with the team.**	**Developed some solutions with higher complexity and worked well with the team.**	**Attempted to develop few solutions and worked with the team.**	**No contribution in developing a solution and in the team.**
	9-10 marks.	**6-8 marks.**	**4-5 marks.**	**0-3 marks**
Project Report Writing	**Worked very well to submit an excellent project report .**	**Worked well to submit the project report with covering all the aspects of a standard report.**	**Tried to submit the project report but standard of report was not satisfactory.**	**No contribution in project report writing.**
	9-10 marks.	**6-8 marks.**	**4-5 marks.**	**0-3 marks**
Project Presentation	**Presented the project work flawlessly.**	**Presented the project work very nice.**	**Presented the project work not so well.**	**Presentation skill is not up to the mark.**
Project Group Members				
ROLL NUMBER/Enrollment Number				
NAME				
Comments (if any)				

NOTE : " These are suggestive rubrics Faculty mentor and external examiner may frame different rubrics as per Programme need and assigned Project work "

C. Self Learning Assessment

Self Learning Assessment **Max Marks -50**

Sr.No.	Criteria	Max Marks	Marks Obtained
1	Project Selection & Problem definition	10	
2	Literature survey and data collection/ Gathering	05	
3	Design / concept of project/ Working - Execution of Project	15	
4	Stage wise progress as per Action plan/milestone/ psychomotor motor skills acquired	10	
5	Quality Report Writing	10	

VIII. CO-PO Mapping

CO-PO mapping will vary project wise and shall be prepared by concerned faculty for the given project

IX. Typographical instructions/guidelines for Project report writing

Following is the suggestive format for preparing the Project report. Actual report may differ slightly depending upon the nature of industry. The training report may contain the following.

a. The PROJECT report shall be computer typed (English- British) and printed on A4 size paper.
b. Text Font -Times New Roman (TNR), Size-12 point
c. Subsection heading TNR- 12 point bold normal
d. Section heading TNR- 12 capital bold
e. Chapter Name/ Topic Name – TNR- 14 Capital
f. All text should be justified. (Settings in the Paragraph)
g. The report must be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.
h. The training report must be hardbound/ Spiralbound with cover page in black colour. The name of the candidate, diploma (department), year of submission, name of the institute shall be printed on the cover [Refer sample sheet (outer cover)]
i. The training report, the title page [Refer sample sheet (inner cover)] should be given first then the Certificate followed by the acknowledgment and then contents with page numbers.

X. Project Report

On completion of the project work, every student will submit a project report which should contain the following:
1. Cover Page (as per annexure 1)
2. Title page (as per annexure 2)
3. Certificate by the Guide (as per annexure 3)
4. Acknowledgment (The candidate may thank all those who helped in the execution of the project.)
5. Abstract (It should be in one page and include the purpose of the study; the methodology used.)
6. Table of Contents (as per general guidelines): Detailed description of the project (This should be split in various chapters/sections with each chapter/section describing a project activity in totality).

Chapter–1 Introduction (background of the Industry or User based Problem/Task)
Chapter–2 Literature Survey (to finalize and define the Problem Statement)
Chapter–3 Scope of the project
Chapter–4 Methodology/Approach, if any
Chapter-5 Details of designs, working and processes
Chapter-6 Results and Applications

7. Conclusion
8. References (The listing of references should be typed 2 spaces below the heading “REFERENCES” in alphabetical order in single spacing left – justified. It should be numbered consecutively (in square [ ] brackets, throughout the text and should be collected together in the reference list at the end of the report. The references should be numbered in the order they are used in the text. The name of the author/authors should be immediately followed by the year and other details). Typical examples of the references are given below:

NOTE:

1. Project report must contain only a relevant and short mention – technology or platform or tools used. It must be more focussed on project work and its implementation
2. Students can add/remove/edit chapter names as per the discussion with their guide

Formats

Project Report

"Project Title----------"

as a partial fulfilment of requirement of the

THIRD YEAR DIPLOMA IN

Submitted by

1)Name Of Student Enrollment Number

2)Name Of Student Enrollment Number

3)Name Of Student Enrollment Number

4)Name Of Student Enrollment Number

Are the bonafide on

FOR THE ACADEMIC YEAR

20-----20---

(H.O.D)

(Principal)

(Internal Guide) **(External Examiner)**

Department Name

(If NBA Accredited mention that)
Institute Name

(An Affiliated Institute of Maharashtra State Board of Technical Education)

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3.	Chapter–3 Scope of the project	
4	Chapter–4 Methodology/Approach, if any	
5	Chapter-5 Details of designs, working and processes	
6.	Chapter-6 Results and Applications	
7.	REFERENCES	

Note:

***Students can add/remove/edit chapter names as per the discussion with their guide**

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Annexure

PROJECT DIARY (Weekly/Daily)

Name of the Student : _____

Name of Guide (Faculty) : _____

Enrollment Number : _____ Semester: _____Project batch Number : _____

WEEK : _____

Date	Activity carried out (Details)	Achievement of mile stone/step as per plan	Remark of Faculty
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			
Saturday			

Dated Signature of Faculty **Dated Signature of HOD**

MSBTE LOGO INST LOGO

Certificate

This is to certify that

Mr./Ms. *bearing examination seat No.* *has*

Satisfactorily completed his/her ***PROJECT*** *entitled*

Along with his/her batchmates in partial fulfillm ent for the

Diploma Course in

< PROGRAMME NAME>

Of the ***Maharashtra State Board of Technical Education*** *at our Polytechnic during the Academic Year20 -20 .*

The Project is completed by a group consisting of Persons under the guidance of the Faculty Guide

Faculty Name and Signature (Internal)	**Faculty Name and Signature (External if applicable)**	**HOD Name and Signature with Department Stamp**
Date and Time		