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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 & Computer Engg.		
Programme Code	: TE	With Effect From Academic Year	: 2023-24
Duration Of Programme	: 6 Semester	Duration	: 16 WEEKS
Semester	: Fourth　　NCrF Entry Level : 3.5	Scheme	: K

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Actual Contact Hrs./ Week CL	TL	LL	Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs / Week	Credits	Paper Duration (hrs.)	Theory FA-TH Max	SA-TH Max	Total Max	Min	Based on LL & TL Practical FA-PR Max	Min	SA-PR Max	Min	Based on Self Learning SLA Max	Min	Total Marks
(All Compulsory)																							
1	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	314301	2	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
2	JAVA PROGRAMMING	JPR	AEC	314317	-	4	-	4	2	10	5	3	30	70	100	40	25	10	50#	20	25	10	200
3	CONSUMER ELECTRONIC SYSTEMS	CEL	DSC	314327	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175
4	MICROCONTROLLER & APPLICATIONS	MAA	DSE	314328	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
5	ANALOG & DIGITAL COMMUNICATION	ADC	DSC	314329	1	4	-	2	-	6	3	3	30	70	100	40	25	10	25@	10	-	-	150
6	PYTHON PROGRAMMING AND DATA STRUCTURE	PPP	SEC	314012	-	2	-	2	-	4	2	-	-	-	-	-	25	10	50@	20	-	-	75
	Total				3	19		16	5		20		150	350	500		125		175		100		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.

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Paper Duration (hrs.)	Assessment Scheme										Total Marks
						Actual Contact Hrs./ Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs / Week			Theory				Based on LL & TL				Based on Self Learning		
																			Practical				
						CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
													Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	

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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ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	**Course Code : 314301**

Programme Name/s	**: Architecture Assistantship/ 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 Science & Engineering/ Fashion & Clothing Technology/** **Dress Designing & Garment Manufacturing/ 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/ Medical Electronics/ Production Engineering/** **Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/** **Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures/**
Programme Code	**: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MU/ PG/ PN/ PO/ SC/ SE/ TC/ TE/ TR/ TX**
Semester	**: Fourth**
Course Title	**: ENVIRONMENTAL EDUCATION AND SUSTAINABILITY**
Course Code	**: 314301**

I. RATIONALE

The survival of human beings is solely depending upon the nature. Thus, threats to the environment directly impact on existence and health of humans as well as other species. Depletion of natural resources and degradation of ecosystems is accelerated due to the growth in industrial development, population growth, and overall growth in production demand. To address these environmental issues, awareness and participation of individuals as well as society is necessary. Environmental education and sustainability provide an integrated, and interdisciplinary approach to study the environmental systems and sustainability approach to the diploma engineers.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Resolve the relevant environmental issue through sustainable solutions

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify the relevant Environmental issues in specified locality.
- CO2 - Provide the green solution to the relevant environmental problems.
- CO3 - Conduct SWOT analysis of biodiversity hotspot
- CO4 - Apply the relevant measures to mitigate the environmental pollution.

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- CO5 - Implement the environmental policies under the relevant legal framework.

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		
314301	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10		125

Total IKS Hrs for Sem. : 2 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 Explain the need of studying environment and its components. TLO 1.2 Investigate the impact of population growth and industrialization on the relevant environmental issues and suggest remedial solutions TLO 1.3 Explain the Concept of 5 R w.r.t. the given situation TLO 1.4 Elaborate the relevance of Sustainable Development Goals in managing the climate change TLO 1.5 Explain the concept of zero	**Unit - I Environment and climate change** 1.1 Environment and its components, Types of Environments, Need of environmental studies 1.2 Environmental Issues- Climate change, Global warming, Acid rain, Ozone layer depletion, nuclear accidents. Effect of population growth and industrialization 1.3 Concept of 5R, Individuals' participation in i) 5R policy, ii) segregation of waste, and iii) creating manure from domestic waste 1.4 Impact of Climate change, Factors contributing to climate change, Concept of Sustainable development, Sustainable development Goals (SDGs), Action Plan on	Lecture Using Chalk-Board Presentations

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ENVIRONMENTAL EDUCATION AND SUSTAINABILITY   **Course Code : 314301**

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.
	carbon-footprint with carbon credit	Climate Change in Indian perspectives 1.5 Zero Carbon footprint for sustainable development, (IKS-Enviornment conservation in vedic and pre-vedic India)	
2	TLO 2.1 Justify the importance of natural resources in sustainable development TLO 2.2 Explain the need of optimum use of natural resources to maintain the sustainability TLO 2.3 Differentiate between renewable and non-renewable sources of energy TLO 2.4 Suggest the relevant type of energy source as a green solution to environmental issues	**Unit - II Sustainability and Renewable Resources** 2.1 Natural Resources: Types, importance, Causes and effects of depletion. (Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources), (IKS-Concepts of Panchmahabhuta) 2.2 Impact of overexploitation of natural resources on the environment, optimum use of natural resources 2.3 Energy forms (Renewable and non-renewable) such as Thermal energy, nuclear energy, Solar energy, Wind energy, Geothermal energy, Biomass energy, Hydropower energy, biofuel 2.4 Green Solutions in the form of New Energy Sources such as Hydrogen energy, Ocean energy & Tidal energy	Lecture Using Chalk-Board Presentations
3	TLO 3.1 Explain the characteristics and functions of ecosystem TLO 3.2 Relate the importance of biodiversity and its loss in the environmental sustainability TLO 3.3 Describe biodiversity assessment initiatives in India TLO 3.4 Conduct the SWOT analysis of the biodiversity hot spot in India TLO 3.5 Explain the need of conservation of biodiversity in the given situation	**Unit - III Ecosystem and Biodiversity** 3.1 Ecosystem - Definition, Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem 3.2 Biodiversity - Definitions, Levels, Value, and loss of biodiversity 3.3 Biodiversity Assessment Initiatives in India 3.4 SWOT analysis of biodiversity hot spot in India 3.5 Conservations of biodiversity - objects, and laws for conservation of biodiversity	Lecture Using Chalk-Board Presentations Video Demonstrations
4	TLO 4.1 Classify the pollution based on the given criteria TLO 4.2 Justify the need of preserving soil as a resource along with the preservation techniques TLO 4.3 Maintain the quality of water in the given location using relevant preventive measures TLO 4.4 State the significance of controlling the air pollution to maintain its ambient quality norms TLO 4.5 Compare the noise level from different zones of city with	**Unit - IV Environmental Pollution** 4.1 Definition of pollution, types- Natural & Artificial (Man- made) 4.2 Soil / Land Pollution – Need of preservation of soil resource, Causes and effects on environment and lives, preventive measures, Soil conservation 4.3 Water Pollution - sources of water pollution, effects on environment and lives, preventive measures, BIS water quality standards for domestic potable water, water conservation 4.4 Air pollution - Causes, effects, prevention, CPCB norms of ambient air quality in residential	Lecture Using Chalk-Board Presentations

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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.
	justification TLO 4.6 Describe the roles and responsibilities of central and state pollution control board	area 4.5 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city 4.6 Pollution Control Boards at Central and State Government level: Norms, Roles and Responsibilities	
5	TLO 5.1 Explain Constitutional provisions related to environmental protection TLO 5.2 Explain importance of public participation (PPP) in enacting the relevant laws TLO 5.3 Use the relevant green technologies to provide sustainable solutions of an environmental problem TLO 5.4 Explain the role of information technology in environment protection	**Unit - V Enviornmental legislation and sustainable practices** 5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental protection and prevention acts 5.2 Public awareness about environment. Need of public awareness and individuals' participation. Role of NGOs 5.3 Green technologies like solar desalination, green architecture, vertical farming and hydroponics, electric vehicles, plant-based packaging 5.4 Role of information technology in environment protection and human health	Lecture Using Chalk-Board Presentations Video Demonstrations

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

-
Suggest the steps to implement (or improve the implementation) of the 5R policy in your home/institute stating your contribution

Draft an article on India's Strategies to progress across the Sustainable Development Goals

Make a chart of Renewable and non-renewable energy sources mentioning the advantages and disadvantages of each source

Conduct the SWOT analysis of biodiversity hotspot in India

Prepare a mind-mapping for the zero carbon footprint process of your field

Prepare a chart showing sources of pollution (air/water/ soil), its effect on human beings, and remedial actions

Any other assignment on relevant topic related to the course suggested by the facilitator

UNICEF Certification(s)

- Students may complete the self-paced course launched by Youth Leadership for climate Exchange under UNICEF program on portal www.mahayouthnet.in . The course encompasses five Modules in the form of Units as given below: -
Unit 1: Living with climate change
Unit 2 : Water Management and Climate Action

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Unit 3: Energy Management and Climate Action
Unit 4 : Waste Management and Climate Action
Unit 5 : Bio-cultural Diversity and Climate Action
If students complete all the five Units they are not required to undertake any other assignment /Microproject/activities specified in the course. These units will suffice to their evaluations under SLA component

Micro project

-
Technical analysis of nearby commercial RO plant.
Comparative study of different filters used in Household water filtration unit
Evaluate any nearby biogas plant / vermicomposting plant or any such composting unit on the basis of sustainabilityand cost-benefit
IKS-Study and prepare a note on Vedic and Pre-Vedic techniques of environmental conversion
Visit a local polluted water source and make a report mentioning causes of pollution
Any other activity / relevant topic related to the course suggested by the facilitator

Activities

-
Prepare a report on the working and functions of the PUC Center machines and its relavance in pollution control.
Prepare and analyse a case study on any polluted city of India
Prepare a note based on the field visit to the solid waste management department of the municipal corporation / local authority
Record the biodiversity of your institute/garden in your city mentioning types of vegetation and their numbers
Visit any functional hall/cultural hall /community hall to study the disposal techniques of kitchen waste and prepare a report suggesting sustainable waste management tool
Watch a video related to air pollution in India and present the summary
Any other assignment on relevant topic related to the course suggested by the facilitator

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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	Nil	All

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

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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Environment and climate change	CO1	8	4	4	4	12
2	II	Sustainability and Renewable Resources	CO2	10	4	4	8	16
3	III	Ecosystem and Biodiversity	CO3	8	4	4	4	12
4	IV	Environmental Pollution	CO4	12	4	8	6	18
5	V	Enviornmental legislation and sustainable practices	CO5	7	4	4	4	12
		Grand Total		**45**	**20**	**24**	**26**	**70**

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 UNICEF Certification(s)/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	-	1	-	-	3	2	3			
CO2	-	2	2	-	3	2	3			
CO3	-	-	-	-	3	1	2			
CO4	1	-	-	-	3	2	2			
CO5	1	-	2	-	3	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	Y. K. Singh	Environmental Science	New Age International Publishers, 2006, ISBN: 81-224-2330-2

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Sr.No	Author	Title	Publisher with ISBN Number
2	Erach Bharucha	Environmental Studies	University Grants Commission, New Delhi
3	Rajagopalan R.	Environmental Studies: From Crisis to Cure.	Oxford University Press, USA, ISBN: 9780199459759, 0199459754
4	Shashi Chawla	A text book of Environmental Science	Tata Mc Graw-Hill New Delhi
5	Arvind Kumar	A Text Book of Enviornmental science	APH Publishing New Delhi (ISBN 978-8176485906)

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://sdgs.un.org/goals	United Nation's website mentioning Sustainability goals
2	http://www.greenbeltmovement.org/news-and-events/blog	Green Belt Movement Blogs on various climatic changes and other issues
3	http://www.greenbeltmovement.org/what-we-do/tree-planting-fo r-watersheds	Green Belt Movement's work on tree plantation, soil conservation and watershed management techniques
4	https://www.youtube.com/ @ierekcompany/videos	International Experts For Research Enrichment and Knowledge Exchange –IEREK's platform to exchange the knowledge in fields such as architecture, urban planning, sustainability
5	www.mahayouthnet.in	UNICEF Intiative for youth leadership for climate action
6	https://eepmoefcc.nic.in/index1.aspx? lsid=297&lev=2&lid=1180 &langid=1	GOI Website for public awareness on enviornmetal issues
7	https://egyankosh.ac.in/ handle/123456789/61136	IGNOU's Intiative for online study material on Enviornmental studies
8	https://egyankosh.ac.in/ handle/123456789/50898	IGNOU's Intiative for online study material on sustainability
9	https://sustainabledevelopment.un.org/ content/documents/1180 3Official-List-of-Proposed-SDG-Indicators.pdf	Final list of proposed Sustainable Development Goal indicators
10	https://sustainabledevelopment.un.org/ memberstates/india	India's Strategies to progress across the SDGs.
11	https://www.un.org/en/development/desa/ financial-crisis/sust ainable-development.html	Challenges to Sustainable Development
12	https://nptel.ac.in/courses/109105190	NPTEL course on sustainable development
13	https://onlinecourses.swayam2.ac.in/ cec19_bt03/preview	Swayam Course on Enviornmetal studies (Natural Resources, Biodiversity and other topics)
14	https://onlinecourses.nptel.ac.in/ noc23_hs155/preview	NPTEL course on enviornmental studies which encomopasses SDGs, Pollution, Cliamate issues, Energy, Policies and legal framework
15	https://www.cbd.int/development/ meetings/egmbped/SWOT-analys is-en.pdf	SWOT analysis of Biodiversity
16	https://www.sanskrit.nic.in/SVimarsha/ V2/c17.pdf	Central sanskrkit university publication on Vedic and pre vedic enviornmetal conservation

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ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	Course Code : 314301
Sr.No **Link / Portal**	**Description**
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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JAVA PROGRAMMING　　　　　　　　　　　　　　　　　　　　　　　Course Code : 314317

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Data Sciences/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science/ Electronics & Computer Engg./**
Programme Code	**: AI/ AN/ BD/ CM/ CO/ CW/ DS/ HA/ IF/ IH/ SE/ TE**
Semester	**: Fourth**
Course Title	**: JAVA PROGRAMMING**
Course Code	**: 314317**

I. RATIONALE

Java is platform independent, open-source object-oriented programming language and used for web applications. Java has the broad industry support and is prerequisite with many allied technologies like Java Server Pages, Android Application Development. This course will enable students to develop applications using java.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Develop standalone and network-based applications using Java.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Develop java program using classes and objects.
- CO2 - Develop java program for implementing code reusability concept.
- CO3 - Develop program to implement multithreading and exception handling.
- CO4 - Develop java program for implementing event handling using window-based application components.
- CO5 - Implements network programming in java.
- CO6 - Develop java program for managing database.

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		
314317	JAVA PROGRAMMING	JPR	AEC	4	-	4	2	10	5	3	30	70	100	40	25	10	50#	20	25	10	200	

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.

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JAVA PROGRAMMING   **Course Code : 314317**

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 Write programs to create classes and objects for the given problem. TLO 1.2 Describe characteristics of the given java token. TLO 1.3 Write program to evaluate given expressions. TLO 1.4 Write programs using relevant control structure to solve the given problem. TLO 1.5 Develop programs using vectors and wrapper classes for the given problem. TLO 1.6 Use constructors for the given programming problem.	**Unit - I Basic Syntactical Constructs in Java** 1.1 Java features and the Java programming environment 1.2 Defining a class, creating object, accessing class members 1.3 Java tokens and data types, symbolic constant, scope of variable, typecasting, and different types of operators and expressions, decision making and looping statements 1.4 Arrays, strings, string buffer classes, vectors, wrapper classes 1.5 Constructors and methods, types of constructors, method and constructor overloading, nesting of methods, command line arguments, garbage collection, visibility control: public, private, protected, default, private protected	Chalk-Board Demonstration Flipped Classroom Presentations
2	TLO 2.1 Apply identified type of inheritance for the given programming problem. TLO 2.2 Differentiate between overloading and overriding with the help of examples. TLO 2.3 Develop program using interface. TLO 2.4 Create user defined package for the given problem.	**Unit - II Inheritance, Interface and Packages** 2.1 Inheritance: concept of inheritance , types of Inheritance: single inheritance, multilevel inheritance, hierarchical inheritance, method overriding, final variables, final methods, use of super, abstract methods and classes 2.2 Interfaces: Define interface, implementing interface, accessing interface variables and methods, extending interfaces 2.3 Package: Define package, types of package, naming and creating package, accessing package, import statement, static import, adding class and interfaces to a package	Lecture Using Chalk-Board Presentations Hands-on Flipped Classroom
3	TLO 3.1 Distinguish the errors and exceptions with example. TLO 3.2 Develop program for handling the given exception. TLO 3.3 Create threads to run multiple processes in a program. TLO 3.4 Develop program using different thread life cycle	**Unit - III Exception Handling and Multithreading** 3.1 Errors and Exception: Types of errors and exceptions, try and catch statement, throws and finally statement, built-in exceptions, throwing our own exception 3.2 Multithreaded programming : creating a thread: By extending to thread class and by implementing runnable Interface, Life cycle of thread: Thread	Lecture Using Chalk-Board Presentations Flipped Classroom Hands-on

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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.
	methods.	methods, thread exceptions, thread priority and methods, synchronization	
4	TLO 4.1 Write steps to develop Graphical User Interface (GUI) using AWT components with frame for the given problem. TLO 4.2 Develop program using menu and dialog boxes for the given problem. TLO 4.3 Write steps to develop Graphical user interface (GUI) using advanced swing components for the given problem. TLO 4.4 Use delegation event model to develop event driven program for the given problem. TLO 4.5 Use relevant AWT/ Swing component(s) to handle the given event.	**Unit - IV Event handling using Abstract Window Toolkit (AWT) & Swings Components** 4.1 Component, container, window, frame, panel, use of AWT controls: labels, buttons, checkbox, checkbox group, textfield, textarea 4.2 Use of layout managers: flowLayout, borderLayout, gridLayout, gridBagLayout, menubars, menus, file dialog 4.3 Introduction to swing: Swing features, difference between AWT and Swing. 4.4 Swing components: Icons and Labels, TextField, ComboBox, Button, Checkbox, RadioButton 4.5 Advanced Swing Components: Tabbed Panes, Scroll Panes, Trees, Tables, Progress bar, tool tips 4.6 Introduction to Event Handling: The delegation Event Model: Event sources, Event listeners 4.7 Event classes: The action event class, the Item event class, the Key event class, the mouse event class, text event 4.8 Event listener interfaces: ActionListener , ItemListener , KeyListener , MouseListener , MouseMotion , TextListener	Lecture Using Chalk-Board Presentations Demonstration Hands-on
5	TLO 5.1 Describe the concepts of sockets in java. TLO 5.2 Use networking classes to retrieve host details. TLO 5.3 Develop program for Client/Server communication through TCP/IP Server sockets for the given problem.	**Unit - V Basics of Network Programming** 5.1 Socket Overview: Client/Server , reserved Sockets , proxy servers , Internet Addressing 5.2 Java and the Net: The networking classes and interfaces, InetAddress : Factory Methods , Instance Methods 5.3 TCP/IP Client and Server Sockets, datagram sockets, datagram packets 5.4 The URL Class, URLConnection class	Lecture Using Chalk-Board Presentations Flipped Classroom Hands-on
6	TLO 6.1 Choose relevant database connectivity methods. TLO 6.2 Describe two tier and three tier architecture of JDBC. TLO 6.3 Choose relevant type of JDBC driver for the specified environment. TLO 6.4 Elaborate steps with example to establish connectivity with the specified database.	**Unit - VI Interacting with Database** 6.1 Introduction to JDBC, ODBC 6.2 JDBC architecture: Two tier and three tier models 6.3 Types of JDBC drivers, Class Class , DriverManager class, Connection interface, Statement interface, PreparedStatement interface, ResultSet Interface	Lecture Using Chalk-Board Presentations Flipped Classroom Hands-on

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

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Install any IDE software application.	1	* Setup Java Programming development environment using: • Command prompt.(Classpath and path setup) • Any IDE (Eclipse, Netbeans, VScode, Jcreator etc.).	2	CO1
LLO 2.1 Implement programs to evaluate different types of Expressions.	2	Write programs to evaluate different types of expressions.	2	CO1
LLO 3.1 Develop program to implement different control structures.	3	Write programs to demonstrate use of: • if statements (all forms of if statement • Switch – Case statement • Different types of Loops(for,while and do..while).	2	CO1
LLO 4.1 Develop program to implement different control structures.	4	*Write programs for implementation of different methods of: • String class. • StringBuffer class.	2	CO1
LLO 5.1 Implement array and vectors in Java.	5	* Write programs to demonstrate: • Use of Array. • Use of Vectors .	2	CO1
LLO 6.1 Convert primitive data types into object and vice-versa.	6	Write programs using Wrapper Class : • to convert primitive into object. • to convert object into primitive.	2	CO1
LLO 7.1 Initialize objects using constructors.	7	Develop a program for implementation of different types of constructors.	2	CO1
LLO 8.1 Implement concepts of inheritance for code reusability.	8	Develop program to implement: • Single inheritance. • Multilevel inheritance.	2	CO2
LLO 9.1 Implement multiple inheritance.	9	* Develop program for implementation of interface.	2	CO2
LLO 10.1 Implement packages in Java.	10	*Write programs to demonstrate use of : • Built in packages • User defined packages.	2	CO2
LLO 11.1 Identify the different types of errors using exception handling.	11	Write programs for implementation of try, catch and finally block.	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 12.1 Manage different types of user defined exceptions.	12	*Write programs for implementation of throw, throws clause.	2	CO3
LLO 13.1 Execute different processes simultaneously using multithreading.	13	*Write programs using multithreading.	2	CO3
LLO 14.1 Design GUI using different AWT components.	14	* Write program to design any type of form using AWT components.	2	CO4
LLO 15.1 Design GUI using different menu class.	15	Write program to create a menu bar with various menu items and sub menu items.	2	CO4
LLO 16.1 Design GUI using border layout manager.	16	Write program to demonstrate the use of border layout. The layout shows four buttons at four sides with captions "left", "right", "top" and "bottom" using Swing Components.	2	CO4
LLO 17.1 Design GUI using grid layout manager.	17	*Write program to design a calculator to demonstrate the use of grid layout using swing components.	2	CO4
LLO 18.1 Implement swing components in a frame.	18	Write program using swing to display a JComboBox in a JFrame .	2	CO4
LLO 19.1 Design tree and table using advanced swing components in a frame.	19	Write program to create JTree and JTable.	2	CO4
LLO 20.1 Implement various keys and mouse events.	20	* Write program to handle key events and mouse events.	2	CO4
LLO 21.1 Implement action event in java.	21	*Write program to implement action event in frame using swing components.	2	CO4
LLO 22.1 Implement text event in java.	22	Write program to handle text event on swing components.	2	CO4
LLO 23.1 Extract the hostname and IP address using InetAddress class.	23	Write program to retrieve hostname and IP address using InetAddress class.	2	CO5
LLO 24.1 Retrieve various components of URL using different methods of URL and URLConnection class.	24	*Write program to demonstrate various methods of: • URL class. • URLConnection.	2	CO5
LLO 25.1 Implement client-server TCP based communication.	25	*Write program that demonstrates connection oriented communication using socket.	2	CO5
LLO 26.1 Implement client-server UDP based communication.	26	Write program to demonstrate sending and receiving data through datagram.	2	CO5
LLO 27.1 Make database connectivity using appropriate JDBC driver.	27	*Write program to: • Create sample database. • Make connectivity with database.	2	CO6
LLO 28.1 Manage database using JDBC.	28	*Write program to implement following operations on database:	2	CO6

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
		• Insert record. • Update record. • Delete record.		
LLO 29.1 Manage database using JDBC.	29	Write program to demonstrate the use of PreparedStatement.	2	CO6
LLO 30.1 Implement dynamic query.	30	*Write program to retrieve data from table using ResultSet interface.(Use various methods of navigation methods).	2	CO6

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)

Other

• Complete any course of Java Programming on Infosys Springboard/Spoken Tutorial/NPTEL
• Develop java code for given problem suggested by course teacher.

Micro project

• Develop mini-ATM machine system. It should accept account_no, account_holder_name, account_balance and perform operations such as withdrawal, Deposit and balance check.
• Develop Quiz Management System. Quiz should accept student credentials and contain 10 MCQ type questions. Determine the final result. Save the result in table along with student credentials.
• Energy Billing System: Expected to develop bill amount module based on usage of energy consumption.
• Develop Employee Management System. Insert employee details such as employee_name, emp_id,emp_salary etc.. into database and retrieve data from table.
• Any other micro project as suggested by course teacher.

Assignment

• Solve assignment covering all COs given by course teacher.

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.

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• 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	Databases like MySQL, Oracle, MS-Access or any other.	27,28,29,30
2	Computer System (Any computer system with basic configuration).	All
3	Computer with JDK1.8 or above, any IDE for Java Programming such as Eclipse, Jcreator, NetBeans,VScode .	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	Basic Syntactical Constructs in Java	CO1	8	4	4	4	12
2	II	Inheritance, Interface and Packages	CO2	10	2	4	6	12
3	III	Exception Handling and Multithreading	CO3	12	2	4	6	12
4	IV	Event handling using Abstract Window Toolkit (AWT) & Swings Components	CO4	14	4	4	8	16
5	V	Basics of Network Programming	CO5	8	2	4	4	10
6	VI	Interacting with Database	CO6	8	2	2	4	8
		Grand Total		**60**	**16**	**22**	**32**	**70**

X.   ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

• Continuous assessment based on process and product related performance indicators.
• Each practical will be assessed considering 60% weightage to process 40% weightage to product
• A continuous assessment based on term work

Summative Assessment (Assessment of Learning)

• End semester examination, Lab performance, Viva voce

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	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3

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					Environment					
CO1	2	2	1	2	--	1	1			
CO2	2	2	2	2	--	1	1			
CO3	2	2	2	2	--	1	1			
CO4	2	2	2	2	1	2	2			
CO5	2	2	3	2	1	2	2			
CO6	2	2	3	3	1	2	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	E Balaguruswamy	Programming with JAVA	Mcgraw Hill Education (India) Private Limited, New Delhi . ISBN-13: 978-93-5134-320-2
2	Schildt Herbert	Java Complete Reference	Mcgraw Hill Education, New Delhi . ISBN:9789339212094
3	Holzner, Steven et al	Java 8 Programming Black Book	Dreamtech Press, New Delhi. ISBN: 978-93-5119-758-4

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.javatpoint.com/java-tutorial	All content
2	https://www.w3schools.com/java/	All content
3	https://www.tutorialspoint.com/java/index.htm	All content
4	https://www.programiz.com/java-programming/online-compiler/	Online compiler for java
5	https://onecompiler.com/java	Online compiler for java
6	https://www.odbms.org/wp-content/uploads/2013/11/009.01-Arlo w-JDBC-Tutorial-July-2005.pdf	Database Connectivity
7	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_29 959473947367270000_shared/overview	All content
8	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_au th_0138420095549112329730_shared/overview	All content
9	https://onlinecourses.nptel.ac.in/noc22_cs47/preview	All content

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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CONSUMER ELECTRONIC SYSTEMS   **Course Code : 314327**

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Electronics & Computer Engg.**
Programme Code	**: DE/ EJ/ ET/ EX/ IE/ TE**
Semester	**: Fourth**
Course Title	**: CONSUMER ELECTRONIC SYSTEMS**
Course Code	**: 314327**

I. RATIONALE

The usage and demand for consumer electronic appliances is increasing in both domestic as well as industries. This increases the demand for trained man power in the relevant industries. This course will provide working principle of various consumer appliances/gadgets /equipments and skills to troubleshoot and maintain them in scientific way. The knowledge gained will help the students in the manufacturing units of these consumer gadgets or help the students to start their own enterprise.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain the following industry/employer expected outcome through various teaching learning experiences.
Maintain various consumer electronic appliances/equipments.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Maintain the given type of audio system.
- CO2 - Test different types of video systems.
- CO3 - Troubleshoot various consumer electronic appliances.
- CO4 - Use various smart appliances.
- CO5 - Maintain various office automation appliances.

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	
314327	CONSUMER ELECTRONIC SYSTEMS	CEL	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

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.

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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 Compare mono, stereophonic and quadraphonic amplifier. TLO 1.2 Explain the controls available on Hi-Fi Amplifier. TLO 1.3 Describe the operating principle and working of the given type of microphone. TLO 1.4 Explain with sketch the construction and working principle of the given type of speaker. TLO 1.5 Draw the block diagram of Public Address System with explanation.	**Unit - I Audio Fundamentals** 1.1 Basic characteristics of sound signal : Intensity and loudness, pitch, frequency response, fidelity, sensitivity and selectivity 1.2 Audio Amplifiers: Mono, stereo, quadraphonic, block diagram of Hi- Fi amplifier and its working, use of bass, treble tone controls 1.3 Microphone: Working principle and Types - condenser, crystal, electret, laser 1.4 Speakers: Working principle and types- electrostatic, dynamic, plasma arc, Bluetooth 1.5 Multi-speaker system: Definition, Crossover Networks, Impedance matching 1.6 Public Address System (PA system) and Home theatre : Block diagram and working principle	Lecture Using Chalk-Board Video Demonstrations Model Demonstration
2	TLO 2.1 Describe working of CCTV system with functional block diagram. TLO 2.2 Describe with block diagram the working of LCD TV. TLO 2.3 Explain the working of LED TV. TLO 2.4 Explain with sketch the functions of given blocks of DTH. TLO 2.5 Write features and applications of Smart interactive TV.	**Unit - II Video Systems** 2.1 Closed circuit television (CCTV): functional block diagram, working ,installation of CCTV 2.2 Liquid crystal display (LCD) television: Principle, Block diagram and working 2.3 Block diagram and working principle: Light emitting diode(LED) TV, Organic light emitting diode(OLED) TV, Quantum dot light emitting diode (QLED) television 2.4 Direct to Home (DTH) television : Block diagram and working principle 2.5 Smart interactive TV : Features and applications	Demonstration Lecture Using Chalk-Board
3	TLO 3.1 Explain with sketch the working of photocopier machine. TLO 3.2 Prepare specifications of a Microwave oven and describe its working.	**Unit - III Consumer Electronic Appliances** 3.1 Photocopier: Block diagram and working principle 3.2 Microwave Oven: Block diagram, single chip controllers, types, wiring diagram, safety instructions, electrical specifications 3.3 Washing Machine: Block diagram, electrical specifications, types and features of (Automatic, Semi-	Lecture Using Chalk-Board Demonstration Site/Industry Visit

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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.
	TLO 3.3 State function of each block of washing machine. TLO 3.4 Describe features of camcorder. TLO 3.5 Explain the working of scanner. TLO 3.6 Describe the working of bar code reader.	automatic and Fuzzy Logic) washing machine 3.4 Digital Camera and Camcorder: Working principle, picture processing, picture storage, electrical specification 3.5 Scanner: Working principle, Specifications, types of scanners (Handheld ,Flatbed, Sheet fed ,Portable Scanners), interface cables, ports and connectors 3.6 Bar code reader: Working principle , applications	
4	TLO 4.1 Explain constructional features with applications of wearable antennas. TLO 4.2 Describe with functional block diagram working of smart wristband. TLO 4.3 Describe with functional block diagram working of VR headset. TLO 4.4 List the augmented reality devices used in classroom. TLO 4.5 State regulations related to recycling of E-waste.	**Unit - IV Smart appliances.** 4.1 Wearable antenna: Construction, Working principle and applications 4.2 Smart Wrist bands :Construction, applications and functional units (sensors ,signal conditioning, microcontrollers, wireless connectivity , power management, firmware, storage) 4.3 Virtual Reality (VR) Headset: Functional block diagram and functional units (tracking unit, processing unit, display unit, sensors, pixel resolution, field of view),virtual reality supported platforms such as Windows Mixed Reality(WMR) 4.4 Augmented Reality(AR) devices: Functional block diagram, working principle, examples 4.5 Recycling of electronic appliances :Regulations and procedures	Lecture Using Chalk-Board Video Demonstrations Flipped Classroom
5	TLO 5.1 Describe the working of a laser printer. TLO 5.2 Explain the function of various controls of LED projector. TLO 5.3 State the features of smart interactive board. TLO 5.4 Describe the working of given component in biometric attendance system. TLO 5.5 Explain functional blocks of video conferencing system with suitable sketch. TLO 5.6 Describe the working of paper shredding machine.	**Unit - V Office Automation appliances** 5.1 Laser Printer: Working principle, features, specifications, functional block diagram, control unit and troubleshooting procedure 5.2 Smart Interactive Board: Working procedure, features and specifications 5.3 LED Projector: Working principle, features, specifications, functional block diagram, control unit and troubleshooting procedure 5.4 Biometric Attendance system: Hardware and software components , working procedure 5.5 Video conferencing system: Components and working procedure 5.6 Paper shredding machine : Components and working procedure	Lecture Using Chalk-Board Presentations Model Demonstration

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 Test and measure the various parameters	1	Performance of given type of	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
of a microphone.		microphone		
LLO 2.1 Test the given speaker and plot its frequency response.	2	*Performance of given speaker	2	CO1
LLO 3.1 Measure voltages at different sections of Hi-Fi amplifier.	3	*Performance of given Hi-Fi amplifier	2	CO1
LLO 4.1 Locate any three different faults by voltage analysis method in a Hi-Fi Audio amplifier.	4	*Fault identification in Hi-Fi amplifier	2	CO1
LLO 5.1 Measure the voltages for various components of CCTV unit.	5	*Test the CCTV unit	2	CO2
LLO 6.1 Connect CCTV Cameras to DVR/IVR, record and replay.	6	Connection of CCTV cameras to DVR/IVR	2	CO2
LLO 7.1 Measure voltage of Power supply , Audio section and Video section of LCD TV. LLO 7.2 Compare the above measured voltage with standard voltage.	7	Voltage analysis of power supply section,audio section and video section of LCD TV	2	CO2
LLO 8.1 Troubleshoot the faults in a LCD TV- a) No picture, No Audio b) No Audio but proper picture. c) Complete dead TV.	8	Fault analysis of LCD TV	2	CO2
LLO 9.1 Test the performance of various sections of given LED TV - a) Power supply b) Driver LED section c) Audio section d) Video section.	9	*Voltage analysis of given sections of LED TV	2	CO2
LLO 10.1 Locate and rectify faults in a LED TV - a) No picture, No Audio b) No Audio but proper picture.c) Complete dead TV .	10	*Fault analysis in LED TV	2	CO2
LLO 11.1 Test the components and operation of the paper feed mechanism in a photocopier machine through dismantling and reassembly.	11	*Dismantling and assembling of paper feed mechanism in photocopier machine	2	CO3
LLO 12.1 Identify and test various front panel controls of microwave oven.	12	*Identification of front panel controls of microwave oven	2	CO3
LLO 13.1 Detect and rectify faults in microwave oven - a) Oven not starting b) Oven not heating c) Error display.	13	*Fault analysis in microwave oven	2	CO3
LLO 14.1 Set the time duration of different wash cycles for a given washing machine.	14	*Performance of washing Machine	2	CO3
LLO 15.1 Sketch the wiring diagram of washing machine and locate its main components.	15	Sketch the wiring diagram of washing machine	2	CO3
LLO 16.1 Troubleshooting of washing machine - a) Excessive noise during operation b) Door lock problem. .	16	Fault analysis of washing machine	2	CO3
LLO 17.1 Test the various functions of Camcorder such as iris and shutter speed control, computer interface, recording rate and recording format.	17	Use the various functions of Camcorder	2	CO3
LLO 18.1 Interface the scanner to the desktop computer and test its various controls.	18	*Interfacing of scanner	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 19.1 Measure the signal strength of wearable antenna.	19	Performance of given wearable antenna	2	CO4
LLO 20.1 Display faults in smart wrist bands - a) display not working b) poor brightness .	20	*Display faults in smart wrist bands	2	CO4
LLO 21.1 Take Back-up of data from wearable device such as wrist band to given drive/ storage device.	21	Data back-up from wearable device	2	CO4
LLO 22.1 Test the VR headset problems - a) Bluetooth connectivity b) USB port connection .	22	Connection problems in VR headset	2	CO4
LLO 23.1 Use the controllers of VR headset to navigate within the virtual environment.	23	Performance of VR headset	2	CO4
LLO 24.1 Interface the laser printer to the desktop computer and identify various controls.	24	*Interfacing of laser printer	2	CO5
LLO 25.1 Detect and remove the faults in laser printer - a) The print quality is not very good. b) White Lines and Streaks. c) Cartridge leakage .	25	* Fault analysis for the cartridge related problems of laser printer	2	CO5
LLO 26.1 Measure the speed of given laser printer.	26	*Performance of laser printer	2	CO5
LLO 27.1 Interface and configure LED projector using various controls.	27	Interfacing of LED projector	2	CO5
LLO 28.1 Create new interactive whiteboard pages using Interactive whiteboard simulation software like Mimio Studio, SMART Learning Suite Online.	28	*Creating new interactive whiteboard pages	2	CO5
LLO 29.1 Test the audio and video settings for a video conferencing session.	29	Assess the quality of a video conferencing session	2	CO5
LLO 30.1 Determine the shredding capacity (number of sheets) and speed (sheets per minute) of a paper shredding machine.	30	Determination of capacity and speed of a shredding machine	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)

Micro project

- Prepare a report on consumer product international standards.
- Do market survey of various models of Camcorder on the basis of different features through online/offline and make a report.

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- Make presentation on functioning of biometric attendance system in institute.
- Develop a PA system for institute conference hall.
- Install and prepare annual maintenance report of SMPS/CCTV available in the institute.

Visit

- Visit to consumer product manufacturing unit.
- Visit to nearby electrical and hardware repair center of consumer appliances and make a report.

Assignment

- Prepare chart on CCTV components and specifications.
- Draw neat sketches of condenser and electret microphones.
- Draw neat sketches of electrostatic and dynamic speakers
- Compare washing machine types, features and electrical specifications

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	Digital Multimeter: 31/2 digit display,9999 counts digital multimeter measures: Vac,Vdc(1000Vmax) Adc, Aac (10 amp max.) Resistance (0-100 M ohm), capacitance and temperature measurements .	1,2,3,4,7,5,8,9,10,12,13,20,22
2	Microwave oven – Supply voltage: 220 volts, 50Hz. single phase A.C. supply, Power Consumption: 1300W approx., Microwave Power: 700W - 850W,Oven Capacity: 20 litres - 25 litres ,Microwave Frequency: 2450 MHz, Control : Soft/one touch control, Timer : 60 minutes - 90 minutes. (any other equivalent) .	12,13
3	Cabinet/panel opener tool set / Telecommunication tool set, screwdriver dissemble tool, crowbar set, Hammer, Pliers, Wire cutter, LAN Crimping Tool, Aligner.	12,13,14,15,16,18,20,21,25
4	Washing machine unit (suitable unit) - 240 V ,50 Hz, Fully automatic control, Max. Spin Speed 780 RPM. (any other equivalent)	14,15,16
5	Camcorder - 4K HDR Video Recording.	17
6	Scanner-type-Flatbed color, Photoelectric device-Color CCD line sensor, effective pixels- 40,800 × 56,160 pixels at 4800 dpi,Scanning resolution-4800 dpi (main scan),9600 dpi with Micro Step (sub scan),Output resolution-50 to 6400, 9600, and 12800 dpi, Image data-16	18

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Sr.No	**Equipment Name with Broad Specifications**	**Relevant LLO Number**
	bits per pixel per color internal,16 bits per pixel per color external (maximum),Interface-One USB port. (any other equivalent) .	
7	Smart wristband , bluetooth synchronization, low power accelerometer sensor, vibration motor support, operating temp -10°C to 50° C ,system requirement –iOS 9.0 and above/Android 5.0 and above. (any other equivalent)	19,20,21
8	Audio level/dB meter - Functions : MAX / MIN / HOLD, Auto Power Off ,Range : 35 dB ~ 130 dB (31.5 Hz ~ 8 kHz),Accuracy : ±1.5 dB (under reference condition), Resolution : 0.1 dB,Power : 9 V Battery.	2,19
9	VR headset- Max Resolution 3664×1920 per eye, Screen Type Fast Twitch LCD, Max Refresh Rate-120Hz, Tracking 6DOF Inside Out Tracking (wireless). (any other equivalent) .	22,23
10	Laser Printer -600 x 600 dpi ,Input capacity-Up to 150 sheets, Output capacity-Up to 100sheets,Media type Paper (laser, plain, photo), Memory - standard 2 MB.(any other equivalent).	24,25,26
11	LED Projector- Built in 10 W speakers, 28dB low noise bright 4000 lumens, versatile connectivity, USB power, long lamp life upto to 15000 hours. (any other equivalent) .	27
12	Simulation Software : mimio studio/SMART Learning Suite Online .	28
13	Desktop PC or laptop with video conferencing platform such as Zoom, Microsoft Teams, Cisco Webex, or Google Meet, cameras, microphones, and speakers compatible with chosen video conferencing platform, stable and high-speed internet connection .	29
14	Hi Fi amplifier system trainer - Hi-Fi Audio Amplifier (Using Power Transistor)Trainer Kit- For Measure Power Transistor Voltages OfDifferent Stages. Demonstration model of Hi Fi amplifier with various test points for wave form tracing, 2 Channel, tone controls bass, treble, blend, master gain control,5+5 band graphic equalizer with fault creation facility.	3,4
15	Automatic/Semi automatic cross-cut shredder/shredding machine with shred Speed- 1.5 m/min and shred capacity of 20 sheets or any suitable configuration .	30
16	CCTV tool monitor- Build in battery: 3.7 volt 3000 mAH, Power Output: 12V DC, Resolution: 480x234, Screen Size: 3.5 Inch.	6,5
17	CAT 5/CAT 6 cable tester.	6,5
18	LCD TV trainer Kit -14" (or other equivalent) with Faults creating switches and test points at various sections.	7,8
19	Cathode Ray Oscillator: DC -30 Mhz dual channel, Rise time:12 ns approx. accuracy :±3 % input impedance:1 M ohm.	7,8,9,10
20	LED Color TV trainer Kit -18 "/21" (or other equivalent) with Faults creating switches and test points at various sections.	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	Audio Fundamentals	CO1	6	2	2	4	8
2	II	Video Systems	CO2	7	4	4	4	12

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CONSUMER ELECTRONIC SYSTEMS								**Course Code : 314327**
Sr.No	**Unit**	**Unit Title**	**Aligned COs**	**Learning Hours**	**R-Level**	**U-Level**	**A-Level**	**Total Marks**
3	III	Consumer Electronic Appliances	CO3	10	4	6	6	16
4	IV	Smart appliances.	CO4	10	4	6	6	16
5	V	Office Automation appliances	CO5	12	4	6	8	18
Grand Total				**45**	**18**	**24**	**28**	**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.
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	3	1	1	3			
CO2	2	1	2	3	1	1	3			
CO3	3	1	2	3	1	1	3			
CO4	2	1	2	3	3	1	3			
CO5	2	1	2	3	1	1	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	Bali S.P.	Consumer Electronics	Pearson Education India, New Delhi,2007;ISBN:9788131717592
2	Bali R and Bali S.P.	Audio video systems: principle practices and troubleshooting	Khanna Book Publishing Co.(P) Ltd.,New Delhi,2014;ISBN:9780070067172

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Sr.No	Author	Title	Publisher with ISBN Number
3	Gupta R.G.	Audio Video Systems: principle and practices and troubleshooting	Mc Graw Hill, New Delhi , 2010; ISBN:9780070699762
4	Whitaker Jerry and Benson Blair	Standard handbook of Audio engineering	McGraw-Hill Education; New Delhi 2010; ISBN -13:9780070067172
5	Glen Ballou	Handbook for Sound Engineering	ELSEVIER-British Library Cataloguing-in-Publication Data,2008; ISBN: 9780240809694
6	Whitaker Jerry and Benson Blair	Mastering Digital Television	McGraw-Hill Professional, New Delhi, 2010; ISBN-13:9780071411806
7	Haider Raad	The Wearable Technology handbook .	Ohio publishing and academic services, Metaverse Edition,2022: ISBN: 9781737233480
8	Murray Ramirez	Virtual Reality for Beginners! How to Understand, Use and Create with VR	Create Space Independent Publishing Platform,2016; ISBN-13 : 9781540532220
9	P Kaliraj, Devi Thirupathi	Innovating with Augmented Reality: Applications in Education and Industry	CRC Press, Taylor and Francis group,ISBN: 9781003175896
10	Jerry D. Gibson.	Multimedia Communications	ISBN:9780122821608

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://ed.iitm.ac.in/~raman/agcl/VR_Paper.pdf	VR Headset
2	https://www.nxp.com/assets/block-diagram/en/AugmentedReality andVirtualRealityHeadsets.pdf	V R Headset
3	https://www.nxp.com/assets/block-diagram/en/SmartWatch_SMART WATCH.pdf	Smart Watch
4	https://www.nxp.com/assets/block-diagram/en/SmartWatch_SMART WATCH.pdf	Smart Watch
5	https://www.nsdcindia.org/scmp/assets/image/1179656187-CCTV_ Installation_Technician__English.pdf	CCTV installation handbook
6	https://toshiba.semicon-storage.com/ap-en/semiconductor/appl ication/multi-function-printer.html	Multifunctional printer/ All-in-one printer
7	http://digimat.in/nptel/courses/video/117105133/L10.html	Perception of sound
8	https://www.coursera.org/learn/introduction-virtual-reality	Introduction to VR
9	https://www.youtube.com/watch?v=d1Lk7EL-XEo	LCD/OLED
10	https://www.youtube.com/watch?app=desktop&v=6-heUDnJaHQ	Simulation for wearable antenna
11	https://www.youtube.com/watch?v=S5n3APXOk_k	Wearable antenna
12	https://www.instructables.com/DIY-LED-Projector/	LED Projector
13	https://da-iitb.vlabs.ac.in/exp/washin-machine-control/simul ation.html	Washing machine simulation
14	https://ijrpr.com/uploads/V4ISSUE3/IJRPR10799.pdf	Paper shredder machine
15	https://core.ac.uk/download/pdf/12008168.pdf	Biometric attendance system.
16	https://www.indiafilings.com/learn/e-waste-management/	Recycling of electronic appliances
17	https://cpcb.nic.in/displaypdf.php?id=aHdtZC9HVUlERUxJTkVTX0 VXQVNURV9SVUxFU18yMDE2LnBkZg==	e waste management

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Sr.No	Link / Portal	Description
18	http://slot-tech.com/interestingstuff/a%20collection%20of%20 technical%20stuff%20from%20a%20technician%20in%20Libya/Print er%20and%20Photocopier%20Troubleshooting%20and%20Repair%20Co llectio.pdf	Printer and Photocopier Troubleshooting and Repair
19	https://www.fau.edu/ehs/info/microwave-fire-safety.pdf	Microwave oven safety instructions.

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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Programme Name/s	: Automation and Robotics/ Digital Electronics/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Instrumentation & Control/ Industrial Electronics/ Instrumentation/ Electronics & Computer Engg.
Programme Code	: AO/ DE/ EJ/ EK/ ET/ EX/ IC/ IE/ IS/ TE
Semester	: Fourth
Course Title	: MICROCONTROLLER & APPLICATIONS
Course Code	: 314328

I. RATIONALE

Microcontrollers plays a very important role in the design, development of embedded systems. Automation is used in every field of engineering and microcontroller is inbuilt component of these systems. Diploma engineers have to deal with various microcontroller based systems and maintain them. This course will enable the students to develop the skills to use and maintain microcontroller based applications.

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:

• Maintain microcontroller based 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 architecture of 8-bit microcontrollers.
- CO2 - Develop program in 8051 in assembly language for the given operation.
- CO3 - Develop program using timers and interrupts.
- CO4 - Interface the memory and I/O peripherals to 8051 microcontroller.
- CO5 - Maintain microcontroller based applications.

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	
314328	MICROCONTROLLER & APPLICATIONS	MAA	DSE	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

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

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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 List the features of 8051 Microcontroller. TLO 1.2 Explain the significance of selection factors while selecting Microcontroller for application. TLO 1.3 Describe the 8051 block diagram. TLO 1.4 Differentiate Microcontroller and Microprocessor for the given parameters. TLO 1.5 Compare Harvard architecture and Von-Neumann architecture. TLO 1.6 Explain functions of each block of 8051 Microcontroller. TLO 1.7 Compare the given derivatives of 8051 Microcontroller.	**Unit - I Microcontroller Overview and 8051 Architecture** 1.1 Features and selection factors for Microcontroller 1.2 Block diagram of 8051 Microcontroller: CPU, input device, output device, memory and buses 1.3 Comparison of Microcontroller and Microprocessor on basis of: Memory, Complexity, Type of Architecture, Cost, Applications, Typical examples of Microcontrollers and Microprocessors 1.4 Architectures of Microcontroller: Harvard , Von Neumann. Concept of pipelining 1.5 8051 Microcontroller: Architecture, Pin Configuration, Memory Organisation, Power saving options 1.6 Derivatives of 8051 (8951, 8031, 8751). Comparison between derivatives	Learning using Chalk-Board Blended Classroom Presentations
2	TLO 2.1 Explain the function of the given software development tools. TLO 2.2 Classify addressing modes of 8051 with examples. TLO 2.3 Describe the function of the given instruction with suitable example. TLO 2.4 Explain the use of the given assembler directives with examples. TLO 2.5 Develop simple programs to perform the following operations: Data manipulation, Masking, Stack operation, Branching execution.	**Unit - II 8051 Programming** 2.1 Software Development Cycle: Editor, Assembler, Compiler, Cross-Compiler, Linker, Locator 2.2 Addressing Modes : Immediate, Register, Direct, Indirect, Indexed 2.3 Instruction set :Data Transfer, Arithmetic, Logical, Branching, Machine control and Boolean 2.4 Assembler Directives: ORG, DB, EQU, END, CODE, DATA 2.5 Assembly Language Programming (ALP): Data manipulation, Masking , Stack operation, Branch related programming	Lecture using Chalk-Board Presentations Blended Learning
3	TLO 3.1 Describe the functions of Timer/ Counters, their applications, and modes of Timers. TLO 3.2 Generate the waveforms by using the given mode of Timer. TLO 3.3 Explain the interrupt mechanism with the help of suitable	**Unit - III 8051 Timers, Interrupts, Serial and Parallel Communication** 3.1 Configuration and Programming of Timer/ Counter using Special Function Registers [SFRs]: TMOD, TCON, THx, TLx, Simple programs to generate the time delays 3.2 Configuration and Programming of interrupts	Lecture using Chalk-Board Hands-on Blended Learning

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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.
	example. TLO 3.4 Explain the operation of given mode for Serial communication. TLO 3.5 Explain I/O Port Programming.	using SFRs: IE, IP 3.3 Serial Communication SFRs: SCON, SBUF, PCON, Modes of serial communication, Simple Programs on serial communication. Serial Communication using MAX 232 3.4 Configuration and Programming of I/O Port : P0, P1, P2, P3	
4	TLO 4.1 Interface Input/Output Devices with 8051 microcontroller. TLO 4.2 Interface ADC with 8051 microcontroller. TLO 4.3 Interface DAC with 8051 microcontroller. TLO 4.4 Describe with neat sketch the interfacing of the given external memory. TLO 4.5 Describe the procedure to troubleshoot the given I/O device.	**Unit - IV 8051 Interfacing** 4.1 I/O Interfacing: Keyboard, Relays, LED, LCD, Seven Segment display 4.2 Interfacing ADC 0808/09 with 8051. Simple programs for ADC interfacing 4.3 Interfacing DAC 0808/09 with 8051. Simple programs for DAC interfacing 4.4 Memory Interfacing: Program and Data Memory	Lecture using Chalk-Board Hands-on Blended Learning Presentations
5	TLO 5.1 Generate the given waveform using 8051 and DAC. TLO 5.2 Interface Analog Input devices with 8051 microcontroller. TLO 5.3 Program 8051 for the given application. TLO 5.4 Interface Stepper motor to 8051. TLO 5.5 Describe the procedure to troubleshoot the given microcontroller based application.	**Unit - V 8051 Applications** 5.1 Square and Triangular waveform generation using DAC 5.2 Temperature sensor (LM35) interfacing using ADC to 8051 5.3 Water Level controller design using 8051 5.4 Stepper Motor Interfacing to 8051 to rotate in clockwise and anticlockwise direction	Lecture using Chalk-Board Hands-on Blended Learning Presentations

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 the functions of various blocks of 8051 microcontroller development board.	1	* Identification of various blocks of 8051 microcontroller development board	2	CO1
LLO 2.1 Develop an Assembly Language Program (ALP) for addition of two numbers using various addressing modes and assembler directives.	2	Assembly Language Program using various addressing modes	2	CO2
LLO 3.1 Develop an ALP to perform arithmetic operations: addition, subtraction, multiplication and division on 8-bit data.	3	* ALP to perform arithmetic operations on 8-bit data	2	CO2
LLO 4.1 Develop an ALP to perform arithmetic operations: addition, subtraction on 16-bit data.	4	* ALP to perform arithmetic operations on 16- bit data	2	CO2
LLO 5.1 Develop an ALP to perform addition of BCD data stored at external memory and store result in internal memory.	5	* ALP to perform addition of BCD data	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	**Sr No**	**Laboratory Experiment / Practical Titles / Tutorial Titles**	**Number of hrs.**	**Relevant COs**
LLO 6.1 Develop an ALP for sum of series of numbers stored in RAM locations 40-49H. Find the sum of the values at the end of the program, store the lower byte in 30H and the higher byte in 31H.	6	* ALP for series addition	2	CO2
LLO 7.1 Develop an ALP to transfer data from source to destination locations of internal/ external data memory.	7	* Array data transfer from source locations to destination locations	2	CO2
LLO 8.1 Develop an ALP to exchange block of data from source to destination location of internal/ external data memory.	8	* Block exchange of data from source locations to destination location	2	CO2
LLO 9.1 Develop an ALP for identifying smallest number from the given data bytes stored in internal/ external data memory.	9	* Finding the smallest number from the given data bytes	2	CO2
LLO 10.1 Develop an ALP for identifying largest number from the given data bytes stored in internal/ external data memory.	10	Finding the largest number from the given data bytes	2	CO2
LLO 11.1 Develop an ALP for arranging numbers in ascending order stored in internal/ external data memory.	11	* Arranging the numbers in ascending order	2	CO2
LLO 12.1 Develop an ALP for arranging numbers in descending order stored in internal/ external data memory.	12	Arranging numbers in descending order	2	CO2
LLO 13.1 Write an ALP to generate delay using timer register.	13	* Generate delay using timer register	2	CO3
LLO 14.1 Develop an ALP to transfer 8 bit data serially on serial port.	14	* Serial 8 bit data transfer on serial port	2	CO3
LLO 15.1 Interface LED with microcontroller and turn it 'ON' with microcontroller interrupt.	15	LED interfacing to 8051	2	CO4
LLO 16.1 Develop an ALP to generate pulse and square wave by using timer delay.	16	Generating Pulse and Square wave using timer delay	2	CO4
LLO 17.1 Interface 4 X 4 LED matrix with 8051 to display various pattern.	17	LED matrix Interfacing to 8051	2	CO4
LLO 18.1 Interface 7-segment display to display the decimal number from 0 to 9.	18	* Seven Segment Display interface for displaying decimal numbers	2	CO4
LLO 19.1 Interface relay with microcontroller and turn it 'ON' and 'OFF'.	19	* Relay interfacing to Microcontroller	2	CO4
LLO 20.1 Interface LCD with 8051 microcontroller to display the characters and decimal numbers.	20	* LCD interfacing to 8051 to display characters and decimal numbers	2	CO4
LLO 21.1 Interface the given keyboard with 8051 and display the key pressed.	21	Keyboard interfacing to 8051	2	CO4
LLO 22.1 Interface ADC with 8051 microcontroller and verify input/output.	22	* ADC interfacing to 8051	2	CO4
LLO 23.1 Interface DAC with 8051 microcontroller to generate square wave.	23	* DAC Interfacing to generate the square waveform	2	CO5
LLO 24.1 Interface DAC with 8051 microcontroller to generate triangular wave, saw-tooth wave.	24	DAC interfacing to generate the triangular waveforms	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 25.1 Interface stepper motor to microcontroller and rotate in clockwise direction at the given angles.	25	* Stepper Motor interfacing to 8051	2	CO5
LLO 26.1 Interface stepper motor to microcontroller and rotate in anti-clockwise direction at the given angles.	26	Stepper Motor interfacing to 8051 for rotating anti-clockwise	2	CO5
LLO 27.1 Design water level controller using any suitable open source simulation software to detect and control the water level in a tank.	27	Water Level Controller using 8051	4	CO5
LLO 28.1 Interface temperature sensor LM35 to 8051 to read temperature, convert it to decimal and send the value to Port 0 with some delay.	28	Temperature Sensor interfacing to detect and measure temperature	4	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)

Micro project

- Build a class period bell using microcontroller 8051.
- Build a circuit using 8051 microcontroller to blink LED.
- Build a circuit to display number 0 to 9 with a given delay.
- Build digital clock with 8051 microcontroller.
- Develop Fire Detection System using smoke and temperature sensor.

Student Activity

- Prepare power point presentation on applications of microcontroller.
- Undertake a market survey of different microcontrollers.

Assignment

- Prepare a chart of various features using data sheets of 8051 microcontroller and its derivatives.
- Prepare chart of stepper motor to display its features and steps for its operations using data sheets.
- Prepare a chart of various types of ADC and DAC to display its features and pin functions using data sheets.
- Prepare a chart of various types of LCDs to display its features , pin functions and steps of operations using data sheets.
- Prepare a power point presentation on 8051 interfacing/applications.

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.

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- 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	DSO with Bandwidth : 50-100 MHz TFT colour LCD Dual channel real time sampling1GSa/s equivalent sampling 25 GSa/s Memory 1Mbpts 10 waveforms and 10 Set up scan be stored.	13,16,23,24
2	4X4 LED matrix suitable to interface with 8051 trainer kit	17
3	7-segment LED Display	18
4	Relay trainer board suitable to interface with 8051 trainer kit	19
5	LCD trainer board	20
6	Keyboard: 4 x 4 trainer board	21
7	ADC(0808) trainer board	22
8	DAC (0808) trainer board	23,24
9	Stepper Motor: 50/100 rpm	25,26
10	Water level controller kit	27
11	Temperature Controller trainer board	28
12	Temperature Sensor LM35: 5V operating voltage, Operating temperature range (°C) -55 to 150, analog output	28
13	8051 Microcontroller kit: On-chip 64 KB ISP+IAP flash, 1KB SRAM, 5V operating voltage, 0 to 40 MHz 64 kB of on-chip Flash program memory	All
14	Desktop PC with microcontroller simulation software.	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	Microcontroller Overview and 8051 Architecture	CO1	11	2	6	6	14
2	II	8051 Programming	CO2	8	4	4	4	12
3	III	8051 Timers, Interrupts, Serial and Parallel Communication	CO3	10	4	4	6	14
4	IV	8051 Interfacing	CO4	10	4	6	8	18
5	V	8051 Applications	CO5	6	2	4	6	12
		Grand Total		**45**	**16**	**24**	**30**	**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 consider 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.

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Summative Assessment (Assessment of Learning)

- End semester assessment is of 70 marks.
- End semester summative assessment is 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			
CO2	2	2	2	2	1	-	2			
CO3	2	2	2	1	1	1	2			
CO4	2	2	2	2	1	-	2			
CO5	2	3	2	2	1	2	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	Mazidi Muhammad Ali, Mazidi Janice Gillispe, Mckinlay Rolin D	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Pearson Publication, 2017 ISBN: 9788131710265
2	Ayala Kenneth J	The 8051 Microcontroller	Thomson Delmar Learning, 2004 ISBN: 9781401861582
3	Deshmukh Ajay V	Microcontroller: Theory and Application	McGraw Hill,2011 ISBN: 9780070585959
4	Pal Ajit	Microcontrollers: Principle and Application	PHI Learning, 2014 ISBN: 978812034394
5	Chattopadhyay Santanu	Microcontroller and Applications	All India Council for Technical Education, 2023 ISBN: 9788196057602

XIII .   LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://vlabs.iitkgp.ac.in/rtes/#	Keyboard-MCU interfacing take a input from keypad and display on LCD
2	https:// studytronics.weebly.com/8051microcontroller.html	8051 Microcontroller Architecture, Internal Memory , Instruction Set, Timers and Counters, Interrupts

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MICROCONTROLLER & APPLICATIONS   **Course Code : 314328**

Sr.No	Link / Portal	Description
3	https://archive.nptel.ac.in/courses/108/105/108105102/	S. Chattopadhyay, SWAYAM/NPTEL course on "Microprocessors and Microcontrollers"
4	https://www.keil.com/download/product/	Introduction to KEIL tool for 8051 programming
5	https://www.dnatechindia.com/Interfacing-LCD-to-8051.html	Interfacing LCD to 8051
6	https://web.mit.edu/6.115/www/document/8051.pdf	MCS@51 Microcontroller family user's manual
7	https://econtent.msbte.edu.in/econtent/marathi_econtent.php	Microcontroller and Applications Learning Material In Marathi-English

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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ANALOG & DIGITAL COMMUNICATION   Course Code : 314329

Programme Name/s	: Electrical and Electronics Engineering/ Medical Electronics/ Electronics & Computer Engg.
Programme Code	: EK/ MU/ TE
Semester	: Fourth
Course Title	: ANALOG & DIGITAL COMMUNICATION
Course Code	: 314329

I. RATIONALE

The importance of electronic communication in our society is incomparable to any other recent development. It has revolutionized communication in both the professional and personal way of human interaction. Without electronic communication, we cannot access and apply the available information in a timely way. This subject will enable students with the basics of analog and digital communication which is used in electronic communication and have greatly impacted our lives.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain the following industry/employer expected outcome through various teaching learning experiences:
Maintain basic analog and digital 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 - Analyze the basics of communication system.
- CO2 - Maintain AM and FM communication systems.
- CO3 - Use various pulse modulation techniques.
- CO4 - Maintain communication systems based on digital modulation techniques.
- CO5 - Select relevant multiplex and multiple access techniques in various communication applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Assessment Scheme											
				Actual Contact Hrs./ Week			SLH	NLH	Credits	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	
314329	ANALOG & DIGITAL COMMUNICATION	ADC	DSC	4	-	2	-	6	3	3	30	70	100	40	25	10	25@	10	-	-	150

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.

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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 Explain the importance of electronic communication. TLO 1.2 Explain block diagram of basic electronic communication system. TLO 1.3 List different types of Noise in communication system. TLO 1.4 Classification of electronic communication. TLO 1.5 Explain the concept of electromagnetic spectrum.	**Unit - I Overview of Electronics Communication** 1.1 Fundamentals of electronic communication: definition of analog signal, digital signal and baseband signal 1.2 Elements of basic electronic communication system: block diagram, function of each block 1.3 Noise in electronic communication system, effects of noise in communication systems, types of noise (internal, external),Signal to Noise ratio, Figure of merit 1.4 Types of electronic communication: simplex, duplex-half and full 1.5 Concept of electromagnetic spectrum and transmission bandwidth 1.6 Ancient communication methods in India: History of communication, non-verbal communication such as drum sounds, pigeons, messenger, symbols, and smoke signals (IKS-1 hour, no question in theory paper)	Lecture using Chalk-Board Demonstration Video Demonstrations
2	TLO 2.1 Describe modulation techniques. TLO 2.2 Explain the process of different analog modulation techniques. TLO 2.3 Explain AM communication systems. TLO 2.4 Explain FM communication systems. TLO 2.5 Calculate modulation index of AM and FM signal.	**Unit - II Analog Modulation Techniques** 2.1 Modulation: Need and classification of modulation techniques 2.2 Amplitude Modulation (AM): Definition, block diagram, waveforms, mathematical representation of AM signal and representation of AM signal in the time domain and frequency domain, modulation index, percentage modulation (numerical) and applications 2.3 Types of AM band spectrum: DSB, SSB, and VSB, power relation in AM wave (no derivation only numerical) 2.4 Generation of AM: Block diagram, working principle and waveform 2.5 Demodulation of AM: Diode detector and practical diode detector (block diagram, working principle) 2.6 Frequency Modulation (FM): Definition, block diagram, working principle, waveform, mathematical representation of FM signal, types of FM (narrowband, wideband), representation of FM signal in the time domain and frequency domain, frequency deviation ratio, modulation index (numerical)	Presentations Lecture using Chalk-Board

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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 Describe block diagram of digital communication techniques. TLO 3.2 Explain different types of Analog Pulse Modulation techniques. TLO 3.3 Describe sampling and quantization process. TLO 3.4 Explain different types of Digital Pulse Modulation techniques. TLO 3.5 Compare different Pulse Modulation techniques.	**Unit - III Pulse Modulation Techniques** 3.1 Elements of Digital Communication system with its block diagram, it's need, advantages, disadvantages and applications 3.2 Classification of pulse modulation, Analog Pulse Modulation: Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM) [definition, block diagram, working principle and waveform] 3.3 Digital Pulse Modulation: Pulse Code Modulation (PCM)- definition, block diagram, working principle with waveform, Sampling theorem, types of sampling, Nyquist sampling theorem, Aliasing effect, Quantization process, Quantization Error 3.4 Digital Pulse modulation: Delta Modulation (DM), Adaptive Delta Modulation (ADM) [only definition, block diagram, working principle with waveform and their comparison] 3.5 Comparison of analog pulse modulation and digital pulse modulation	Lecture using Chalk-Board Video Demonstrations Presentations
4	TLO 4.1 Explain different types of digital modulation techniques. TLO 4.2 Describe M-ary encoding techniques. TLO 4.3 Explain the different types of M-ary techniques. TLO 4.4 Compare digital modulation techniques with respect to different parameter.	**Unit - IV Digital Modulation Techniques** 4.1 Digital modulation techniques: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase-shift keying (BPSK), Quadrature Phase Shift Keying (QPSK), Quadrature Amplitude Modulation (QAM)- block diagram and their working principle and waveform 4.2 M-ary Encoding technique: Definition and it's need 4.3 Types of M-ary Encoding techniques: M-ary ASK, M-ary FSK,M-ary PSK 4.4 Comparison of digital modulation techniques: ASK,FSK and PSK	Lecture using Chalk-Board Presentations Video Demonstrations
5	TLO 5.1 Explain multiplexing of signals. TLO 5.2 Explain different multiplexing techniques. TLO 5.3 Compare different multiplexing techniques on the basis of different parameter. TLO 5.4 Explain different multiple access techniques. TLO 5.5 Explain telemetry process.	**Unit - V Multiplexing and Multiple Access Techniques** 5.1 Multiplexing: Need and classification 5.2 Multiplexing techniques:Time Division Multiplexing (TDM),Frequency Division Multiplexing (FDM), Code Division Multiplexing (CDM) [definition, block diagram, working principle, waveform] 5.3 Multiple Access techniques: Time Division Multiple Access(TDMA), Frequency Division Multiple Access (FDMA),Code Division Multiple Access(CDMA) [definition, block diagram, working principle, waveform] 5.4 Comparison of multiple access techniques: TDMA ,FDMA and CDMA 5.5 Telemetry system: It's need ,types, block diagram, working principle and applications	Presentations Lecture using Chalk-Board Video Demonstrations Site/Industry Visit

VI.   LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL

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ANALOG & DIGITAL COMMUNICATION　　　　　　　　　**Course Code : 314329**

EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Test the output of simplex and duplex mode of communication.	1	*Simplex, half duplex and full duplex communication link using switches, wires and LEDs.	2	CO1
LLO 2.1 Interpret the effect of change in modulating frequency on AM signal.	2	AM modulated waveforms in different modulating frequencies.	2	CO2
LLO 3.1 Generate Amplitude Modulated wave. LLO 3.2 Measure modulation index of an AM envelope.	3	*Modulation of a high frequency carrier with sinusoidal signal to obtain AM signal.	2	CO2
LLO 4.1 Generate Frequency Modulated wave.	4	Generation of FM modulated wave for different carrier frequency.	2	CO2
LLO 5.1 Generate AM wave using any simulation software for given carrier frequency.	5	Generation of AM wave using any simulation software for given carrier frequency.	2	CO2
LLO 6.1 Generate FM wave using given carrier frequency.	6	Use any simulation software to generate FM wave for a given carrier frequency.	2	CO2
LLO 7.1 Generate Natural and Flat top sampled signal.	7	*Generation of Natural and Flat top sampled signal.	2	CO3
LLO 8.1 Test the performance of the Pulse Code modulated and demodulated wave. LLO 8.2 Observe and draw input and output waveform.	8	*Performance of the Pulse Code modulator/ demodulator circuit.	2	CO3
LLO 9.1 Generate ASK Modulated and Demodulated wave. LLO 9.2 Observe and draw input and output waveform	9	*Performance of the Amplitude Shift Keying(ASK) Modulator and Demodulator circuits.	2	CO4
LLO 10.1 Generate FSK Modulated and Demodulated wave. LLO 10.2 Observe and draw input and output waveform.	10	Performance of the Frequency Shift Keying(FSK) Modulator and Demodulator circuits.	2	CO4
LLO 11.1 Generate PSK Modulated and Demodulated wave. LLO 11.2 Observe and draw input and output waveform.	11	*Performance of the Binary Phase Shift Keying(BPSK) Modulator and Demodulator circuits.	2	CO4
LLO 12.1 Generate QAM modulated and demodulated wave. LLO 12.2 Observe and draw input and output waveform.	12	Performance of Quadrature Amplitude Modulation(QAM) modulator and demodulator circuits.	2	CO4
LLO 13.1 Test the performance for n-input time division multiplexing (TDM) signal. LLO 13.2 Observe and draw input and output waveform.	13	Performance for n-input time division multiplexing (TDM) circuit.	2	CO5
LLO 14.1 Test the performance for n-input frequency division multiplexing	14	*Performance for n-input frequency division multiplexing (FDM) circuit.	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	**Sr No**	**Laboratory Experiment / Practical Titles / Tutorial Titles**		**Number of hrs.**	**Relevant COs**
(FDM) signal. LLO 14.2 Observe and draw input and output waveform.					
LLO 15.1 Generate TDM signal using relevant simulation software. LLO 15.2 Observe simulation output for TDM transmitter and receiver.	15	*Generation of TDM signal using relevant simulation software.		2	CO5
LLO 16.1 Generate FDM signal using relevant simulation software. LLO 16.2 Observe simulation output for FDM transmitter and receiver.	16	Generation of FDM signal using relevant 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.

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

NA

- NA

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	Spectrum analyzer, 9 kHz to 1.5 GHz Frequency range- Typical -135 dBm Displayed Average Noise Level (DANL)	1,2
2	RF signal generator with wide frequency range 100KHz to 150 MHz fine frequency adjustment by calibrated dial built in audio frequency generator wideband oscillator Wide Frequency Range 100 KHz to 150 MHz.	2,3,4
3	AM and FM Trainer kit for Modulation and Demodulation.	2,3,4

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
4	Simulation software suitable for communication experiments: MATLAB/ Simulink, SCILAB.	6,5,16,15
5	Digital Communication Trainer, In-built internal data generator. Type of Modulations and Demodulations: Sampling. Line coding. PCM, DPCM, ASK, FSK, BPSK, QAM, TDM, FDM, TDMA, FDMA.	8,9,2,3,13,5,7,10,12,11,4
6	CRO – 20MHz Dual Trace Dual Channel Oscilloscope with Component Tester	All
7	Function Generator: Frequency Range 0.1Hz to 30MHZ	All
8	Digital storage oscilloscope, 50MHz and above, dual trace, component tester	All
9	3 1/2 digit display, 9999 counts measures: Vac, Vdc (1000V max), Adc, Aac (10 Amp max), Resistance(0-100 Mohm), Capacitance and Temperature measurement (optional).	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	Overview of Electronics Communication	CO1	10	2	4	6	12
2	II	Analog Modulation Techniques	CO2	12	4	4	6	14
3	III	Pulse Modulation Techniques	CO3	14	4	6	6	16
4	IV	Digital Modulation Techniques	CO4	12	4	6	6	16
5	V	Multiplexing and Multiple Access Techniques	CO5	12	4	4	4	12
Grand Total				60	18	24	28	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. For formative assessment of laboratory learning 25 marks. Each practical will be assessed consider 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	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3

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					Environment						
CO1	1	1	1	2	1		2				
CO2	1	1	1	2	1		2				
CO3	1	1	1	2	1		2				
CO4	1	1	1	2	1		2				
CO5	1	1	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	Tomasi, Wayne	Electronic Communication Systems	Pearson Education, Delhi, 2009, ISBN NO. 9788131719534
2	P. Ramakrishna Rao	Digital Communication	McGraw Hill, Delhi, 2011, ISBN NO. 978-0070707764
3	Kennedy George, Davis Bernard	Electronic Communication system	McGraw Hill Education, ISBN 0-02-800592-9
4	Louis E. Frenzel Jr.	Principles Of Electronic Communication System	McGraw Hill, Delhi, ISBN13: 9781259932793
5	Shanmugan, K. Sam	Digital and Analog Communication System	Willey India Edition, ISBN: 81-265-0914-7
6	Sklar, Bernald	Digital Communication	Pearson Education India, Delhi, Second Edition,2014,ISBN:9781292026060

XIII .　LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/117/102/117102059/	Introduction to Electronics Communication.
2	https://archive.nptel.ac.in/courses/117/105/117105144/	Introduction to Digital Communication.
3	https://onlinecourses.nptel.ac.in/noc22_ee05/preview	Principles of Communication Systems - I
4	https://www.youtube.com/watch?v=t8uP2koj_KQ	Communication channel
5	https://www.etti.unibw.de/labalive/experiment/amtransmitterrecodaudiodemo	AM transmitter 1-record audio transmit signal via file
6	https://www.etti.unibw.de/labalive/experiment/am/	Amplitude modulation
7	https://www.etti.unibw.de/labalive/experiment/qpsksignalgeneration/	QPSK signal generation
8	https://www.etti.unibw.de/labalive/index/digitalmodulation/	Digital modulation
9	https://www.etti.unibw.de/labalive/experiment/qpskberequivalentbasebandwopulseshaping/	QPSK bit error rate - equivalent baseband
10	https://www.etti.unibw.de/labalive/experiment/qpsk/	QPSK transmission
11	https://www.etti.unibw.de/labalive/manual/	INTERACTIVE SIMULATION OF COMMUNICATION SYSTEMS
12	https://www.youtube.com/watch?v=qQcpnmJNluU&list=PLF84ABD7D4EBA31C4	Digital Communication Systems

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Sr.No	Link / Portal	Description
13	http://www.digimat.in/nptel/courses/video/102104068/L09.html	Radio-telemetry
14	https://profhkverma.info/wp/wp-content/uploads/2017/04/Ch-1-Telemetry-Basics.pdf	Telemetry-Basics
15	https://youtu.be/L5jJIN8Z4lo?si=9JMyRy2QU67mluPX	Multiplexing in communication
16	https://youtu.be/vfcb1adKUyo?si=yOomBtg_-9b8Lw2u	Multiple access techniques

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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PYTHON PROGRAMMING AND DATA STRUCTURE	Course Code : 314012

Programme Name/s : Electronics & Computer Engg.

Programme Code : TE

Semester : Fourth

Course Title : PYTHON PROGRAMMING AND DATA STRUCTURE

Course Code : 314012

I. RATIONALE

Python being a powerful programming language with efficient data structures provides an effective approach to Object-oriented programming. Its simplicity and readability make it an excellent language for cultivating problem-solving skills and algorithmic thinking for beginners. Its elegant, simple, and easy-to-understand syntax with its interpreted nature makes it an ideal language for scripting and application development in the field of Electronics and Computer Engineering.

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:
Develop python program using data structures for given purpose.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Develop python program to implement basic building blocks of python.
- CO2 - Perform operations on python data structures
- CO3 - Create modules and packages for given purpose.
- CO4 - Evaluate algorithmic complexity of different searching and sorting algorithms.
- CO5 - Implement Linear Data Structures like stack, queue, linked list using python.

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	
314012	PYTHON PROGRAMMING AND DATA STRUCTURE	PPP	SEC	2	-	2	-	4	2	-	-	-	-	-	25	10	50@	20	-	-	75

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.

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PYTHON PROGRAMMING AND DATA STRUCTURE   **Course Code : 314012**

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 basic constructs of Python. TLO 1.2 Write python programs using input output statements with indentation and comments. TLO 1.3 Write python program to evaluate arithmetic expressions. TLO 1.4 Develop programs using Conditional Statements. TLO 1.5 Develop programs using Loop statements.	**Unit - I Basic Building blocks in Python** 1.1 Introduction to Python- Features of python, Python Identifiers, Keywords, Variables, Constants, Indentation, Comments in python 1.2 Python's Data Types – Numbers, Strings, List, Tuples, Dictionaries, Sets 1.3 Input and output statements 1.4 Operators in Python- Operators as Arithmetic, Assignment, Unary Minus, Relational, Logical, Boolean, Bitwise, Membership, Identity, Operator precedence and Associativity 1.5 Decision Making Statements: - if, if….else, else-if ladder, nested if and switch statement 1.6 Looping statements: - while loop, for loop, nested loop, Manipulating Loops using break, continue and pass statements	Lecture Using Chalk-Board Demonstration Hands-on
2	TLO 2.1 Develop a program to manipulate List for given purpose. TLO 2.2 Develop a program to manipulate Tuples for given purpose. TLO 2.3 Develop a program to manipulate Sets for given purpose. TLO 2.4 Develop a program to manipulate Dictionaries for given purpose.	**Unit - II Data Structures in Python** 2.1 List- Defining List, Creating list, Accessing elements of list, Updating the elements of a list, In built functions for list, Lis operators- Concatenation of two lists, Repeating of Lists, Membership in list, isOperator, del operator, Aliasing and cloning Lists, List Methods, Nested Lists 2.2 Tuples- Defining Tuple, Creating Tuples, Accessing the Tuple elements, Inserting elements in a Tuple, modifying elements of a Tuple, Deleting elements from a Tuple, Basic operations in Tuples, Functions to process Tuples, Nested Tuples 2.3 Sets- Defining Set, Creating a Set, Accessing elements from set, Add and update Set, Remove an elements from a Set, Built in functions with Set, Set methods to perform mathematical operations, other relevant set methods 2.4 Dictionaries- Defining Dictionary, Creating Dictionary, Accessing elements from Dictionary, Traversing Dictionaries, Add and update Dictionary, Delete an element from a Dictionary, Built in functions of Dictionary, Methods of Dictionary class	Presentations Demonstration Hands-on Flipped Classroom

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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 Use python built-in functions. TLO 3.2 Develop relevant user defined function for the given purpose. TLO 3.3 Develop a python module in python for given purpose. TLO 3.4 Develop a python package for given purpose. TLO 3.5 Use NumPy for performing mathematical operations on arrays. TLO 3.6 Develop python program to create objects.	**Unit - III Functions, Modules and Packages** 3.1 Python Functions- Use of python built in functions (e.g. type/data conversion functions, math and string functions), User defined function- Function definition, function calling, function arguments and parameter passing, Return statement, scope of variables (Global and Local Variables) 3.2 Modules- Writing modules, importing module, python built in modules (Numeric and mathematical module, Functional Programming Module) 3.3 Python packages- Introduction, Writing python packages, using standard packages (NumPy) and user defined package statements 3.4 Concept of Classes and Objects- Creating classes and objects in python, Constructors and Destructors in python, Data abstraction and Encapsulation	Presentations Lecture Using Chalk-Board Demonstration Hands-on
4	TLO 4.1 Describe Abstract Data Type (ADT). TLO 4.2 Write an algorithm to search the specific key using given search method. TLO 4.3 Write an algorithm to sort elements using given sorting technique. TLO 4.4 Calculate complexity of given algorithm in terms of Time and space. TLO 4.5 Develop python code to perform searching operation on given array elements. TLO 4.6 Develop python code to perform sorting operation on given array elements.	**Unit - IV Fundamentals of Data Structure and Algorithm** 4.1 Introduction to Data Structure: Concept, Need of Data Structure, Abstract Data Type (ADT), Classification of Data Structures, Operations to be performed on Data Structures, Algorithm, Analysis of algorithm using Time and space Complexity 4.2 Searching and Sorting: Linear Search, Binary Search, Bubble Sort, Selection Sort, Insertion Sort	Presentations Lecture Using Chalk-Board Demonstration Hands-on
5	TLO 5.1 Develop an algorithm to perform PUSH and POP operations for the given stack. TLO 5.2 Develop an algorithm to perform operations on Queue. TLO 5.3 Develop an algorithm to perform operations on singly linked	**Unit - V Linear Data Structures using Python** 5.1 Stack: Stack As Abstract Data Type (ADT), Stack Representation in memory using array, Stack Terminologies, Stack Operations- PUSH, POP, Stack Application 5.2 Queue: Queue As Abstract Data Type (ADT), Linear Queue Representation in memory using array, Linear Queue Operations- Insertion, Deletion, Queue Application 5.3 Linked list: Introduction to Linked List, Singly Linked List representation, Operations on Singly Linked List-	Lecture Using Chalk-Board Presentations Demonstration Hands-on

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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.**
	list.	Create a linked list, Traverse a linked list, Insertion of a new node in Linked list, Deletion of a node from linked list, Applications of Linked List		

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 Install python Integrated Development Environment. LLO 1.2 Write simple python program to evaluate given expression.	1	a) Installation of python IDE. b) Develop python program to calculate equivalent registers connected in series and parallel. Accept values of R1, R2 and R3 from the user. c) Develop python program to calculate value of voltage by applying Ohm's law. Accept value of Current(I) and Resistance(R) from the user.	2	CO1
LLO 2.1 Implement two-way branching statement. LLO 2.2 Implement multi-way branching statement.	2	a) Develop python program to check whether the entered frequency is radio frequency or audio frequency. b) Develop python program to display various radio frequency bands using if..elseif ladder. c) Develop python program to display resistor color code using switch statement.	2	CO1
LLO 3.1 Implement control loops for solving iterative problems.	3	*a) Develop python program to demonstrate use of control loops: i) while ii) do while *b) Develop program to demonstrate use of for loop in python (e.g.: various pattern building, printing multiplication table, checking palindrome number etc.)	2	CO1
LLO 4.1 Perform basic operations on the Lists in python.	4	*Develop python program to perform following operations on List: a) Create b) Access c) Update d) Delete elements from list	2	CO2
LLO 5.1 Execute various tuple operations in python.	5	*Develop python program to perform following operations on Tuples: a) Create b) Access c) Update d) Delete Tuple elements	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	**Sr No**	**Laboratory Experiment / Practical Titles / Tutorial Titles**	**Number of hrs.**	**Relevant COs**
LLO 6.1 Implement various set operations in python.	6	Develop python program to perform following operations on Set: a) Create b) Access c) Update d) Delete Set elements	2	CO2
LLO 7.1 Execute various operations on Dictionaries in python.	7	Develop python program to perform following operations on Dictionaries in Python: a) Create b) Access c) Update d) Delete e) Looping through Dictionary	2	CO2
LLO 8.1 Use built-in mathematical functions and string functions in python. LLO 8.2 Create user defined functions in python.	8	a) Develop python program to demonstrate use of math and string built in function. b) Develop python program to implement half adder and full adder by creating function with the help of user defined function.	2	CO3
LLO 9.1 Implement class to create object in python.	9	Develop python program to define class Student with data members (Roll no, Name, Course, Percentage) as input and then print the details.	2	CO3
LLO 10.1 Use built-in python mathematical modules. LLO 10.2 Write user-defined module in python.	10	*a) Develop python program to demonstrate use of: Built-in module (e.g. numeric, mathematical functional and programming module) in python. *b) Develop python program to create a user-defined module (e.g.: building calculator) in python.	2	CO3
LLO 11.1 Use python built-in packages. LLO 11.2 Implement user-defined packages in python.	11	*a) Develop python program to demonstrate use of NumPy package for creating, accessing and performing different array operations. *b) Develop program to demonstrate the use of user defined packages in python.	2	CO3
LLO 12.1 Implement searching techniques in python.	12	Implement searching techniques using python a) Linear Search b) Binary Search	2	CO4
LLO 13.1 Implement sorting techniques in python.	13	*Implement sorting techniques using python a) Bubble Sort b) Selection Sort c) Insertion Sort	2	CO4
LLO 14.1 Implement Stack as Abstract Data Type in python. LLO 14.2 Implement Queue as Abstract Data Type in	14	*a) Develop python program to implement Stack operations (PUSH, POP) using Array. *b) Develop python program to implement Queue operations (enqueue, dequeue) using Array.	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
python.				
LLO 15.1 Implement Linked List in python.	15	*Develop python program to implement operations (Create, Insert, Delete, Traverse) on Singly Linked List.	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)

Micro project

- Not Applicable.

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	a) Computer System with all necessary peripherals and internet connectivity. b) Any relevant python IDE like IDLE/PyCharm/VSCode/Jupiter Notebook/ OnlinePython Compiler.	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	Basic Building blocks in Python	CO1	4	0	0	0	0
2	II	Data Structures in Python	CO2	6	0	0	0	0
3	III	Functions, Modules and Packages	CO3	6	0	0	0	0

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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
4	IV	Fundamentals of Data Structure and Algorithm	CO4	6	0	0	0	0
5	V	Linear Data Structures using Python	CO5	8	0	0	0	0
		Grand Total		**30**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Each practical will be assessed considering – 60% weightage to process and – 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester summative assessment of 50 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	1	1	1	1						
CO2	1	1	1	1						
CO3	1	2	2	3			1			
CO4	1	3	2	1			1			
CO5	1	2	2	1			1			

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	David M. Beazley	Python Essential Reference	Addison Wesley, 4th Edition ISBN-13: 978-0-672-32978-4
2	Martin C. Brown	The complete Reference Python	Tata McGraw Hill ISBN: 9789387572942
3	Dr. Charles R. Severance	Python for Everybody	Shroff Publishers ISBN-13: 978-9352136278
4	Mark Lutz	Learning Python	O'Reilly, 4th Edition ISBN: 978-0-596-15806-4

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Sr.No	Author	Title	Publisher with ISBN Number
5	Ashok Namdev Kamthane Amit Ashok Kamthane	Programming and problem solving with Python	McGraw Hill Education (India) Private Limited ISBN-13: 978-93-87067-58-5
6	Michael T. Goodrich Roberto Tamassia Michael H. Goldwasser	Data Structures and Algorithms in Python	WILEY Publication ISBN: 978-1118290279
7	Benjamin Baka	Data Structures and Algorithms Using Python	Packt Publishing Ltd. ISBN: 978-1-78646-735-5
8	Rance D. Necaise	Data Structures and Algorithms Using Python	WILEY Publication ISBN: 978-0-470-61829-5

XIII .   LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://python-iitk.vlabs.ac.in/Introduction.html	Basic constructs of python
2	https://www.learnpython.org	Python specific data structure
3	https://www.tutorialspoint.com/python/python_classes_objects.htm	OOP concepts using Python
4	https://www.pythontutorial.net/python-oop/	Object Oriented Programming Concepts
5	https://www.programiz.com/dsa/algorithm https://www.programiz.com/dsa/data-structure-types	Introduction to Data Structure
6	https://www.programiz.com/dsa/stack https://www.programiz.com/dsa/queue https://www.programiz.com/dsa/linked-list https://www.programiz.com/dsa/linked-list-operations	Linear Data Structure using Python

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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