Maharashtra State Board Of Technical Education, Mumbai

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

Programme Name	**: Diploma In Information Technology / Computer Science & Information Technology**		
Programme Code	**: IF / IH**	**With Effect From Academic Year**	**2023-24**
Duration Of Programme	**: 6 Semester**	**Duration**	**: 16 WEEKS**
Semester	**: Third** **NCrF Entry Level : 3.5**	**Scheme**	**: K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme												
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning		Total Marks
																	Practical						
						CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
													Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
(All Compulsory)																								
1	DATA STRUCTURE USING C	DSU	DSC	313301	-	3	1	4	-	8	4	3	30	70	100	40	50	20	25#	10	-	-	175
2	DATABASE MANAGEMENT SYSTEM	DMS	DSC	313302	-	3	1	4	2	10	5	3	30	70	100	40	50	20	25#	10	25	10	200
3	OBJECT ORIENTED PROGRAMMING USING C++	OOP	SEC	313304	-	3	2	4	1	10	5	3	30	70	100	40	50	20	25@	10	25	10	200
4	DIGITAL TECHNIQUES AND MICROPROCESSORS	DTM	AEC	313305	-	3	-	2	1	6	3	3	30	70	100	40	25	10	25@	10	25	10	175
5	ESSENCE OF INDIAN CONSTITUTION	EIC	VEC	313002	-	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-	50	20	50
6	APPLIED MULTIMEDIA TECHNIQUES	AMT	SEC	313003	-	1	-	2	1	4	2	-	-	-	-	-	25	10	-	-	25	10	50
Total						**14**	**4**	**16**	**6**		**20**		**120**	**280**	**400**		**200**		**100**		**150**		**850**

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment,SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

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

Note :

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

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

Programme Name/s	**: Architecture Assistantship/ Architecture and Interior Design/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Bamboo Technology/ 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/ Hotel Management & Catering Technology/ Instrumentation & Control/ Instrumentation & Control Engineering/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Manufacturing Technology/ Medical Electronics/ Metallurgical Engineering/ Production Engineering/ Printing Technology/ Polymer Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures**
Programme Code	**: AA/ AD/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DBT/ DC/ DD/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ ICE/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MRT/ MU/ MY/ PG/ PN/ PO/ SE/ TC/ TE/ TR/ TX/**
Semester	**: Third**
Course Title	**: ESSENCE OF INDIAN CONSTITUTION**
Course Code	**: 313002**

I. RATIONALE

This course will focus on the basic structure and operative dimensions of Indian Constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The Constitution of India is the supreme law of India. The document lays down the framework demarcating the fundamental political code, structure, procedures, powers, and sets out fundamental rights, directive principles, and the duties of citizens. The course on constitution of India highlights key features of Indian Constitution that makes the students a responsible citizen. In this online course, we shall make an effort to understand the history of our constitution, the Constituent Assembly, the drafting of the constitution, the preamble of the constitution that defines the destination that we want to reach through our constitution, the fundamental right constitution guarantees through the great rights revolution, the relationship between fundamental rights and fundamental duties, the futurist goals of the constitution as incorporated in directive principles and the relationship between fundamental rights and directive principles.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry /employer expected outcome – Abide by the Constitution in their personal and professional life.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - List salient features and characteristics of the constitution of India.

- CO2 - Follow fundamental rights and duties as responsible citizen of the country.
- CO3 - Analyze major constitutional amendments in the constitution.
- CO4 - Follow procedure to cast vote using voter-id.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313002	ESSENCE OF INDIAN CONSTITUTION	EIC	VEC	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-	50	20	50

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

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the meaning of preamble of the constitution. TLO 1.2 Explain the doctrine of basic structure of the constitution. TLO 1.3 List the salient features of constitution. TLO 1.4 List the characteristics of constitution.	**Unit - I Constitution and Preamble** 1.1 Meaning of the constitution of India. 1.2 Historical perspectives of the Constitution of India. 1.3 Salient features and characteristics of the Constitution of India. 1.4 Preamble of the Constitution of India.	Presentations Blogs Hand-outs Modules Flipped classrooms Case studies

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Enlist the fundamental rights. TLO 2.2 . Identify fundamental duties in general and in particular with engineering field. TLO 2.3 Identify situations where directive principles prevail over fundamental rights.	**Unit - II Fundamental Rights and Directive Principles** 2.1 Fundamental Rights under Part-III. 2.2 Fundamental duties and their significance under part-IV-A. 2.3 Relevance of Directive Principles of State Policy under part-IV A.	Presentations Blogs Hand-outs Modules Case Study Flipped Classroom
3	TLO 3.1 Enlist the constitutional amendments. TLO 3.2 Elaborate the elements of Centre-State Relationship TLO 3.3 Analyze the purposes of various amendments.	**Unit - III Governance and Amendments** 3.1 3.1 Amendment procedure of the Constitution and their types - simple and special procedures. 3.2 The Principle of Federalism and its contemporary significance along with special committees that were setup. 3.3 Major Constitutional Amendment procedure - 1st, 7th, 42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, 102nd	Cases of Federal disputes with relevant Supreme court powers and Judgements Presentations Blogs Hand-outs Problem based learning
4	TLO 4.1 Explain the importance of electoral rights. TLO 4.2 Write the step by step procedure for process of registration TLO 4.3 Explain the significance of Ethical electoral participation TLO 4.4 Explain the steps to motivation and facilitation for electoral participation TLO 4.5 Enlist the features of the voter's guide TLO 4.6 Explain the role of empowered voter TLO 4.7 Write the steps of voting procedure TLO 4.8 Write steps to create voter awareness TLO 4.9 Fill the online voter registration form TLO TLO 4.10 Follow procedure to cast vote using voter-id.	**Unit - IV Electoral Literacy and Voter's Education** 4.1 Electoral rights , Electoral process of registration 4.2 Ethical electoral participation 4.3 Motivation and facilitation for electoral participation 4.4 Voter's guide 4.5 Prospective empowered voter 4.6 Voting procedure 4.7 Voter awareness 4.8 Voter online registration https:/ /www.ceodelhi.gov.in/ELCdetails.aspx	Presentations Hand-outs Modules Blogs Problem based Learning

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

- Outline the procedure to submit application for Voter-id

- Assignments are to be provided by the course teacher in line with the targeted COs.

A1. Prepare an essay on Constitution of India .
A2 Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA

- Assignments are to be provided by the course teacher in line with the targeted COs. A1. Prepare an essay on Constitution of India . A2 Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA A3. Self-learning topics: Parts of the constitution and a brief discussion of each part Right to education and girl enrollment in schools. GER of Girls and Boys. Right to equality. Social Democracy. Women Representation in Parliament and State Assemblies. LGBTQIA+

Micro project

- 1. Organize a workshop-cum discussions for spreading awareness regarding Fundamental Rights of the citizen of the country

2. Prepare elaborations where directive principle of State policy has prevailed over Fundamental rights with relevant Supreme Court Judgements.
3. Organize a debate on 42nd, 97th and 103rd Constitutional Amendment Acts of Constitution of India.

Seminar

- 1 Differences in the ideals of Social democracy and Political democracy.

2 Democracy and Women's Political Participation in India.
3 Khap Panchayat - an unconstitutional institution infringing upon Constitutional ethos.
4 Situations where directive principles prevail over fundamental rights.

Group discussions on current print articles.

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- Art 356 and its working in Post-Independent India.
- Women's Resrvation in Panchayat leading to Pati Panchayats - Problems and Solutions.
- Adoption of Article 365 in India.
- Need of Amendments in the constitution.
- Is India moving towards a Unitary State Model ?

Activity

- Arrange Mock Parliament debates.

Prepare collage/posters on current constitutional issues.
i. National (Art 352) & State Emergencies (Art 356) declared in India.
ii. Seven fundamental rights.
iii. Land Reforms and its effectiveness - Case study of West-Bengal and Kerala.

Cases: Suggestive cases for usage in teaching:

- A.K. Gopalan Case (1950) :SC contented that there was no violation of Fundamental Rights enshrined in Articles 13, 19, 21 and 22 under the provisions of the Preventive Detention Act, if the detention was as per the procedure established by law. Here, the SC took a narrow view of Article 21.

Shankari Prasad Case (1951) : This case dealt with the amendability of Fundamental Rights (the First Amendment's validity was challenged). The SC contended that the Parliament's power to amend under Article 368 also includes the power to amend the Fundamental Rights guaranteed in Part III of the Constitution.
Minerva Mills case (1980) :This case again strengthens the Basic Structure doctrine. The judgement struck down 2 changes made to the Constitution by the 42nd Amendment Act 1976, declaring them to violate the basic structure. The judgement makes it clear that the Constitution, and not the Parliament is supreme.
Maneka Gandhi case (1978) :A main issue in this case was whether the right to go abroad is a part of the Right to Personal Liberty under Article 21. The SC held that it is included in the Right to Personal Liberty. The SC also ruled that the mere existence of an enabling law was not enough to restrain personal liberty. Such a law must also be "just, fair and reasonable."
Other cases:
1. Kesavananda Bharati Case (1973) : In this case the Hon. SC laid down a new doctrine of the 'basic structure' (or 'basic features') of the Constitution. It ruled that the constituent power of Parliament under Article 368 does not

enable it to alter the ‘basic structure’ of the Constitution. This means that the Parliament cannot abridge or take away a Fundamental Right that forms a part of the ‘basic structure’ of the Constitution.
2. Mathura Rape Case(1979) : A tribal woman Mathura (aged 14 to 16 years) was raped in Police Custody. The case raised the questions on the idea of 'Modesty of Woman' and here it was was a tribal woman who succumbs to multiple pattiarchies. Custodial rape was made an offence and was culpable with the detainment of 7 years or more under Section 376 of Indian Penal Code. The weight of proofing the allegations moved from the victim to the offender, once sexual intercourse is established. The publication of the victim’s identity was banned and it was also held that rape trials should be conducted under the cameras.
3. Puttswamy vs Union of India (2017) : In this landmark case which was finally pronounced by a 9-judge bench of the Supreme Court on 24th August 2017, upholding the fundamental right to privacy emanating from Article 21. The court stated that Right to Privacy is an inherent and integral part of Part III of the Constitution that guarantees fundamental rights. The conflict in this area mainly arises between an individual’s right to privacy and the legitimate aim of the government to implement its policies and a balance needs to be maintained while doing the same.
4. Navtej Singh Johar & Ors. v. Union of India (2018) : Hon. SC Decriminalised all consensual sex among adults, including homosexual sex by scrapping down section 377 of the Indian penal code (IPC). The court ruled that LGBTQ community are equal citizens and underlined that there cannot be discrimination in law based on sexual orientation and gender.
5. Anuradha Bhasin Judgement (2020) : The Supreme Court of India ruled that an indefinite suspension of internet services would be illegal under Indian law and that orders for internet shutdown must satisfy the tests of necessity and proportionality. The Court reiterated that freedom of expression online enjoyed Constitutional protection, but could be restricted in the name of national security. The Court held that though the Government was empowered to impose a complete internet shutdown, any order(s) imposing such restrictions had to be made public and was subject to judicial review.

Note :

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

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

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Constitution and Preamble	CO1	4	0	0	0	0
2	II	Fundamental Rights and Directive Principles	CO2	4	0	0	0	0
3	III	Governance and Amendments	CO3	4	0	0	0	0
4	IV	Electoral Literacy and Voter’s Education	CO4	3	0	0	0	0
Grand Total				**15**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Assignment, Self-learning and Terms work Seminar/Presentation

Summative Assessment (Assessment of 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	-	-	-	2	-	-			
CO2	1	-	-	-	2	-	-			
CO3	1	2	-	-	2	-	1			
CO4	-	-	-	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	P.M.Bakshi	The Constitution of India	Universal Law Publishing, New Delhi 15th edition, 2018, ISBN: 9386515105 (Check the new edition)
2	D.D.Basu	Introduction to Indian Constitution	Lexis Nexis Publisher, New Delhi, 2015, ISBN:935143446X
3	B. K. Sharma	Introduction to Constitution of India	PHI, New Delhi, 6thedition, 2011, ISBN:8120344197
4	MORE READS :	Oxford Short Introductions - The Indian Constitution by Madhav Khosla. The Indian Constitution: Cornerstone of a Nation by Granville Austin. Working a Democratic Constitution: A History by Garnville Austin Founding Mothers of the Indian Republic: Gender Politics of the Framing of the Constitution by Achyut Chetan. Our Parliament by Subhash C. Kashyap. Our Political System by Subhash C. Kashyap. Our Constitution by Subhash C. Kashyap. Indian Constitutional Law by Rumi Pal.	Extra Read
5	B.L. Fadia	The Constitution of India	Sahitya Bhawan,Agra, 2017, ISBN:8193413768

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.legislative.gov.in/constitution-of-india	Constitution overview
2	https://en.wikipedia.org/wiki/Constitution_of_India	Parts of constitution

ESSENCE OF INDIAN CONSTITUTION **Course Code : 313002**

Sr.No	Link / Portal	Description
3	https://www.india.gov.in/my-government/constitution-india	Constitution overview
4	https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/	Fundamental rights and duties
5	https://main.sci.gov.in/constitution	Directive principles
6	https://legalaffairs.gov.in/sites/default/files/chapter%203.pdf	Parts of constitution
7	https://www.concourt.am/armenian/legal_resources/world_constitutions/constit/india/india-e.htm	Parts of constitution
8	https://constitutionnet.org/vl/item/basic-structure-indian-constitution	Parts of constitution

Note :

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

APPLIED MULTIMEDIA TECHNIQUES **Course Code : 313003**

Programme Name/s : **Information Technology/ Computer Science & Information Technology**
Programme Code : **IF/ IH**
Semester : **Third**
Course Title : **APPLIED MULTIMEDIA TECHNIQUES**
Course Code : **313003**

I. RATIONALE

Multimedia and Animation Techniques make connections between verbal and visual representations of contents. This practical oriented course help students to produce different components of Multimedia including text, images, audio, video and animation in order to use them in applications.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Construct different types of Multimedia.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Manipulate color models of image.
- CO2 - Perform edit operation on text and images using graphics processing tools.
- CO3 - Perform basic audio editing operations.
- CO4 - Perform basic video editing operations.
- CO5 - Create simple 2D Animation.
- CO6 - Design Web Pages with Multimedia components.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313003	APPLIED MULTIMEDIA TECHNIQUES	AMT	SEC	1	-	2	1	4	2	-	-	-	-	-	25	10	-	-	25	10	50

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

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

APPLIED MULTIMEDIA TECHNIQUES **Course Code : 313003**

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 Define Multimedia and its applications. TLO 1.2 Describe types of display. TLO 1.3 Describe component of Multimedia. TLO 1.4 Describe various color models.	**Unit - I Introduction to Multimedia** 1.1 Definition of Multimedia, application of Multimedia: business, education. 1.2 Multimedia System Framework, Display System (LCD, LED, OLED, QLED, Foldable). 1.3 Component of Multimedia: text, graphics, audio, video and animation 2D and 3D. 1.4 Color models like RGB, CMYK, HSV, YIQ, saturation and brightness.	Demonstration Presentations Hands-on Lecture Using Chalk-Board
2	TLO 2.1 Convert text one form to another format. TLO 2.2 Describe different effects on text. TLO 2.3 Describe various image file formats. TLO 2.4 Compare Lossy and Lossless image compression techniques. TLO 2.5 Compare characteristics of 2D and 3D images.	**Unit - II Text and Image Editing** 2.1 Types of text format: plain text, RTF, PDF format. 2.2 Conversion of text one form to another format. Text effects (Ketchup, rope, Fire). 2.3 Graphics format: -Vector graphics formats: SVG, WMF, EPS, PDF, CDR -Raster Format: JPEG, PNG, TIFF, PNG, GIF, WebP, BMP and MPEG4. 2.4 Image compression techniques Lossy and Lossless. 2.5 Image effects: broken mirror effect, flaming ball effects, water drop effect. 2.6 2D and 3D images.	Demonstration Presentations Hands-on Lecture Using Chalk-Board
3	TLO 3.1 Describe features of given audio file formats. TLO 3.2 Compare Lossless vs Lossy compression.	**Unit - III Working with Audio** 3.1 Digital audio, Features of audio file formats: mp3, wav, mpeg7, mpeg21. 3.2 Lossless compressed audio format, Lossy compressed audio format. 3.3 MIDI, Mono, Stereo. 3.4 File Size.	Demonstration Presentations Flipped Classroom Hands-on
4	TLO 4.1 Explain digital video standards. TLO 4.2 Describe features of given video file format. TLO 4.3 Explain working of video streaming. TLO 4.4 Describe different types of Animations.	**Unit - IV Working with Videos and Animations** 4.1 Digital video, Broadcast video standards. 4.2 Video file formats: MPEG7, AVI, MP4, WMV. 4.3 Video Streaming: Introduction, Difference between streaming and downloading, working of streaming, buffering, factors affecting streaming. 4.4 Types of Animation: Object (Rolling Ball and Bouncing Ball) and Process animation, 2D, 3D, motion capture, motion graphics, morphing.	Presentations Video Demonstrations Hands-on Lecture Using Chalk-Board
5	TLO 5.1 Describe concept of action script. TLO 5.2 Write steps to develop a webpage and upload or publish web page. TLO 5.3 Explain concept of Virtual, Augmented and Mixed Reality.	**Unit - V Webpage Designing with Multimedia Components** 5.1 Programming concepts with respect to action script: variables, data types, conditionals, loops, arrays, functions. 5.2 Design web pages using Hypertext and Hypermedia. 5.3 Upload or publish web page. 5.4 Fundamentals and gadgets of Virtual, Augmented and Mixed Reality.	Presentations Video Demonstrations Presentations Site/Industry Visit

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

APPLIED MULTIMEDIA TECHNIQUES **Course Code : 313003**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Implement different color models on image. LLO 1.2 Convert given image format into other format for optimum solution.	1	a. *Manipulate color related attributes of given images using any graphical processing tools on RGB, CMYK, HSV, YIQ color models. b. *Convert given image into different image formats, observe and report the changes in image with respect to quality and file size.	2	CO1 CO2
LLO 2.1 Implement various effects on text.	2	*Apply different effects on text using 2D image processing software such as: • Drop shadow • Mirror • Reflection	2	CO2
LLO 3.1 Implement different effects on image.	3	Apply different effects on GIF image using 2D image processing software such as: • Image mirroring • Rainy season effect	2	CO2
LLO 4.1 Create advertising banner.	4	Design advertising banner using graphics processing tools.	2	CO2
LLO 5.1 Create wallpaper showing water drop effect on image.	5	Design wallpaper showing water drop effect on GIF image using any 2D image processing software.	2	CO2
LLO 6.1 Design poster by using different text effect.	6	*Apply different effects on text to design poster using 2D image processing software such as: • Ketchup • Rope • Fire • Fruit	2	CO2
LLO 7.1 Implement given style on image.	7	Apply different style effects in JPEG image using 2D image processing software.	2	CO2
LLO 8.1 Implement Audio editing operations.	8	*Apply convert, merge, cut and join operation on digital audio files.	2	CO3
LLO 9.1 Implement Video editing operations.	9	Apply convert, merge, cut and join operation on video using video processing tool.	2	CO4
LLO 10.1 Apply shape twinning and motion effect in 2D animation.	10	Apply shape twinning and motion in 2D animation using 2D animation software.	2	CO5
LLO 11.1 Apply bouncing and rolling ball down effect in 2D animation.	11	*Apply bouncing and rolling ball down in 2D animation using 2D animation software.	2	CO5
LLO 12.1 Embed animation with audio into web page.	12	* Develop webpage which show animation with sound effect using any professional HTML5 editor.	2	CO3 CO6
LLO 13.1 Embed MP4 video into webpage.	13	* Develop webpage by embedding video using any professional HTML5 editor.	2	CO4 CO6
LLO 14.1 Embed Video Streaming on Web Page.	14	Develop a webpage for embedded video streaming using professional HTML5 editor.	2	CO4 CO6
LLO 15.1 Create simple animation.	15	*Create animation for rotating ball with action script using animation software such as Blender.	2	CO5 CO6

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 16.1 Apply Augmented Reality phenomena using relevant gadgets.	16	* Identify and experience Augmented Reality phenomena using gadgets such as smart phone/ google glass.	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)

Micro project

- The microproject has to be industry application based, internet-based, workshop-based, laboratory-based or field-based as suggested by Teacher.
- Produce your college video for annual event.
- Design banner for departmental event.
- Develop interactive animated web page.
- Create animation clip for internal working of any one machine.
- Develop 2D animation clip for any cartoon story of 5 min.
- Produce 2D animation clip for advertising any product.

Other

- Explore information about mixed reality tools.
- Complete any one course related to multimedia on Infosys Springboard.
- Use ChatGPT/H20.ai or any other AI tool to explore information about image types and their differences.

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	Pencil 2D, OpenOffice draw, Microsoft Paint or any other such software.	1,5
2	Pencil 2D, Blender or any such software.	10,11
3	Pencil 2D, Blender or any such software Notepad++ or any advance HTML5 editor	12,13,14,15
4	Smart Phone / Google Glass or any other such device.	16
5	GIF Animator online tools: www.fotor.com any other such software.	2,3,4,7
6	Online Tool: https://flamingtext.com/ or any other such tool.	6
7	MP3 Cutter or any such software.	8

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
8	OpenShot Video Editor, Video Maker or any other such software.	9
9	Hardware: Computer (i3 onwards), with minimum 4GB RAM. Operating System: Windows 7/10/11 or Linux latest version.	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Multimedia	CO1	2	0	0	0	0
2	II	Text and Image Editing	CO2	4	0	0	0	0
3	III	Working with Audio	CO3	2	0	0	0	0
4	IV	Working with Videos and Animations	CO4,CO5	4	0	0	0	0
5	V	Webpage Designing with Multimedia Components	CO6	3	0	0	0	0
Grand Total				**15**	**0**	**0**	**0**	**0**

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.

Summative Assessment (Assessment of Learning)

- NA

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	-	-	-			
CO2	1	-	-	1	-	-	-			
CO3	1	-	-	1	1	-	1			
CO4	1	1	-	1	1	-	2			
CO5	1	2	1	2	1	1	2			
CO6	2	1	2	1	1	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	Tay Vaughan	Multimedia: Making it work,9e	McGraw Hill Education, New Delhi 2015, ISBN:9780071832885

Sr.No	Author	Title	Publisher with ISBN Number
2	Parekh Ranjan	Principles of Multimedia 2e	McGraw Hill Education, New Delhi.2015, ISBN-13: 978-1-25-900650-0 ISBN-13: 1-25-900650-6
3	Colin Moock	Essential ActionScript 3.0	O'Reilly Media, Inc. ISBN: 9780596526948

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://helpx.adobe.com/in/animate/how-to/create-2d-animation.html	2D animation
2	https://photography.tutsplus.com/tutorials/learn-2d-animation-basics-in-blender--cms-41862	2D animation
3	https://www.gimp.org/tutorials/	Image editing
4	https://www.tutorialspoint.com/multimedia/	Multimedia concept
5	http://edutechwiki.unige.ch/en/AS3_Tutorials_Beginner	ActionScript
6	https://www.cloudflare.com/learning/performance/what-is-streaming/	Video Streaming
7	https://www.youtube.com/watch?v=vz0UUVDt2ps	Virtual Reality and Augmented Reality
8	https://drive.uqu.edu.sa/_/mskhayat/files/MySubjects/20178FS%20Multimedia%20Systems/Fundamentals_of_multimedia_2e.pdf	Fundamentals of Multimedia by Li, Ze-Nian

Note :

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

Programme Name/s	**: Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science**
Programme Code	**: BD/ CM/ CO/ CST/ CW/ HA/ IF/ IH/ SE**
Semester	**: Third**
Course Title	**: DATA STRUCTURE USING C**
Course Code	**: 313301**

I. RATIONALE

One of the most important courses in information and communication technology is data structures. Data organization or structuring is essential for developing effective algorithms and programs. Students will get the ability to develop logic to solve problem using principles of data structure with the aid of this course.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Implement algorithm using relevant Data Structures.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Perform basic operations on Arrays.
- CO2 - Apply different Searching and Sorting methods.
- CO3 - Implement basic operations on Linked List.
- CO4 - Perform operations on Stack using Array and Linked List Implementations.
- CO5 - Perform operations on Queue using Array and Linked List Implementations.
- CO6 - Create and Traverse Tree to solve problems.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313301	DATA STRUCTURE USING C	DSU	DSC	3	1	4	-	8	4	3	30	70	100	40	50	20	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 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 Classify the given type of Data Structures based on their characteristics and space. TLO 1.2 Perform operations on the given type of Data Structure.	**Unit - I Introduction to Data Structures** 1.1 Introduction: Concept and Need of Data Structure, Definition, Abstract Data Type 1.2 Types of Data Structures: (i) Linear Data Structures (ii) Non-Linear Data Structures 1.3 Operations on Data Structures: (i) Traversing (ii) Insertion (iii) Deletion	Lecture Using Chalk-Board Presentations
2	TLO 2.1 Develop algorithm to search the given key using different Searching Techniques. TLO 2.2 Create algorithm to sort data using a given method.	**Unit - II Searching and Sorting** 2.1 Searching: Searching for an item in a data set using the following methods: (i) Linear Search (ii) Binary Search 2.2 Sorting: Sorting of data set in an order using the following methods: (i) Bubble Sort (ii) Selection Sort (iii) Insertion Sort (iv) Quick Sort (v) Merge Sort	Lecture Using Chalk-Board Demonstration Presentations Hands-on
3	TLO 3.1 Differentiate between Static and Dynamic Memory Allocation. TLO 3.2 Create a suitable structure using a Linked List to represent a Node. TLO 3.3 Create Algorithm to add or remove a specified item from a Linear Linked List.	**Unit - III Linked List** 3.1 Difference between Static and Dynamic Memory Allocation. 3.2 Introduction to Linked List, Terminologies: Node, Address, Pointer, Information field / Data field, Next pointer, Null Pointer, Empty List. 3.3 Type of Lists: Linear List, Circular List, Representation of Doubly Linked List. 3.4 Operations on a Singly Linked List: Creating a Linked List, Inserting a new node in a Linked List, Deleting a node from a Linked List, Searching a key in Linked List, Traversing a Singly Linked List. 3.5 Applications of Linked List.	Lecture Using Chalk-Board Demonstration Presentations Hands-on

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Represent Stack using Array and Linked List. TLO 4.2 Create Algorithm to carry out the PUSH and POP operations in a Stack. TLO 4.3 Use Stack to transform the given expression from Infix to Postfix. TLO 4.4 Evaluate Postfix Expression.	**Unit - IV Stack** 4.1 Introduction to Stack: Definition, Stack as an ADT, Operations on Stack-(Push, Pop), Stack Operation Conditions – Stack Full / Stack Overflow, Stack Empty /Stack Underflow. 4.2 Stack Implementation using Array and representation using Linked List. 4.3 Applications of Stack: Reversing a List, Polish Notations, Conversion of Infix to Postfix Expression, Evaluation of Postfix Expression. 4.4 Recursion: Definition and Applications.	Lecture Using Chalk-Board Demonstration Presentations Hands-on
5	TLO 5.1 Represent Queue using Array and Linked List. TLO 5.2 Explain the characteristics of different types of Queue. TLO 5.3 Create Algorithm to carry out the INSERT and DELETE Operations on a Queue.	**Unit - V Queue** 5.1 Introduction to Queue: Queue as an ADT, Queue representation in memory using Array and representation using a Linked List. 5.2 Types of Queues: Linear Queue, Circular Queue, Concept of Priority Queue, Double-Ended Queue. 5.3 Queue Operations: INSERT, DELETE, Queue Operation Conditions: Queue Full, Queue Empty. 5.4 Applications of Queue.	Lecture Using Chalk-Board Demonstration Presentations Hands-on
6	TLO 6.1 Describe the given Tree Terminology. TLO 6.2 Create a Binary Search Tree based on the provided data. TLO 6.3 Create Algorithms to Traverse the Tree using the given method. TLO 6.4 Create an Expression Tree. TLO 6.5 Create Heap.	**Unit - VI Tree** 6.1 Introduction to Trees Terminologies: Tree, Degree of a Node, Degree of a Tree, Level of a node, Leaf Node, Depth / Height of a Tree, In-Degree and Out-Degree, Path, Ancestor and Descendant Nodes. 6.2 Tree Types and Traversal methods, Types of Trees: General Tree, Binary Tree, Binary Search Tree (BST). Binary Tree Traversal: In-Order Traversal, Preorder Traversal, Post-Order Traversal. 6.3 Expression Tree, Heap	Lecture Using Chalk-Board Demonstration Presentations 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
LLO 1.1 Implement Array Operations.	1	* Write a ‘C’ program to perform following Operations on Array: Create, Insert, Delete, Display.	4	CO1
LLO 2.1 Implement Linear Search Method on Numbers.	2	Write a ‘C’ Program to Search a particular data from the given Array of numbers using: Linear Search Method.	2	CO2
LLO 3.1 Implement Linear Search Method on Strings.	3	* Write a ‘C’ Program to Search a particular data from the given Array of Strings using Linear Search Method.	2	CO2
LLO 4.1 Implement Binary Search Method on Numbers.	4	* Write a ‘C’ program to Search a particular data from the given Array of numbers using Binary Search Method.	2	CO2
LLO 5.1 Implement Binary Search Method on Strings.	5	Write a ‘C’ Program to Search a particular data from the given Array of Strings using Binary Search Method.	2	CO2
LLO 6.1 Apply Bubble Sort method for Sorting Numbers.	6	* Write a ‘C’ Program to Sort an Array of numbers using Bubble Sort Method.	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Apply Bubble Sort method for Sorting Strings.	7	Write a 'C' Program to Sort an Array of Strings using Bubble Sort Method.	2	CO2
LLO 8.1 Apply Selection Sort for Sorting Numbers.	8	* Write a 'C' Program to Sort an Array of numbers using Selection Sort Method.	2	CO2
LLO 9.1 Apply Selection Sort for Sorting Strings.	9	Write a 'C' Program to Sort an Array of Strings using Selection Sort Method.	2	CO2
LLO 10.1 Apply Insertion Sort for Sorting Numbers.	10	* Write a 'C' Program to Sort an Array of numbers using Insertion Sort Method.	2	CO2
LLO 11.1 Apply Insertion Sort for Sorting Strings.	11	Write a 'C' Program to Sort an Array of Strings using Insertion Sort Method.	2	CO2
LLO 12.1 Create Singly Linked List.	12	* Write a 'C' Program to Implement Singly Linked List with Operations: (i) Insert at beginning, (ii) Search, (iii) Display	2	CO3
LLO 13.1 Perform given Operations on Singly Linked List.	13	* Write a C Program to Implement Singly Linked List with Operations: (i) Insert at end, (ii) Insert After, (iii) Delete (iv) Display	2	CO3
LLO 14.1 Create Polynomials using Linked List.	14	Write a C Program to Create Two Polynomials using a Linked List.	2	CO3
LLO 15.1 Perform the Addition of Two Polynomials using a Linked List.	15	* Write a 'C' Program to add Two Polynomials using a Linked List.	2	CO3
LLO 16.1 Perform Operations on the Stack using the Array.	16	* Write a 'C' Program to perform PUSH and POP Operations on Stack using an Array.	2	CO4
LLO 17.1 Perform Operations on the Stack using a Linked List.	17	* Write a 'C' Program to perform PUSH and POP Operations on a Stack using a Linked List.	2	CO4
LLO 18.1 Apply recursive procedure to multiply two numbers.	18	* Write a 'C' program to perform multiplication of two numbers using recursion.	2	CO4
LLO 19.1 Apply recursive procedure to reverse the string.	19	Write a 'C' program to print given string in reverse using recursion.	2	CO4
LLO 20.1 Apply recursive procedure to display linked list in reverse.	20	Write a 'C' program to create a Singly Linked List and traverse in reverse order using recursion.	4	CO3 CO4
LLO 21.1 Perform Operations on Linear Queue using Array.	21	* Write a 'C' Program to perform INSERT and DELETE Operations on Linear Queue using an Array.	2	CO5
LLO 22.1 Perform Operations on Linear Queue using Linked List.	22	* Write a 'C' Program to perform INSERT and DELETE operations on Linear Queue using a Linked List.	2	CO5
LLO 23.1 Perform Operations on Circular Queue using Array.	23	* Write a 'C' Program to perform INSERT and DELETE operations on Circular Queue using an Array.	2	CO5
LLO 24.1 Perform Operations on Circular Queue using a Linked List.	24	Write a 'C' Program to perform INSERT and DELETE operations on Circular Queue using a Linked List.	2	CO5
LLO 25.1 Implement Priority Queue using Linked List.	25	Write a 'C' Program to Create a Priority Queue using a Linked List.	4	CO5
LLO 26.1 Implement Binary Search Tree and perform In-Order Traversal.	26	* Write a 'C' Program to Implement BST (Binary Search Tree) and Traverse in In-Order.	2	CO6

DATA STRUCTURE USING C **Course Code : 313301**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 27.1 Implement Tree Traversal Operations.	27	Write a 'C' Program to Traverse BST in Preorder, and Post-Order.	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) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer System with all necessary Peripherals and Internet Connectivity. ‘C’ Compiler / GCC Compiler/ Online ‘C’ 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	Introduction to Data Structures	CO1	2	2	2	0	4
2	II	Searching and Sorting	CO2	8	2	2	8	12
3	III	Linked List	CO3	12	2	4	10	16
4	IV	Stack	CO4	8	2	4	6	12
5	V	Queue	CO5	6	2	2	6	10
6	VI	Tree	CO6	9	2	4	10	16
Grand Total				**45**	**12**	**18**	**40**	**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 and 40% weightage to Product

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

CO1	2	-	-	1	-	-	1			
CO2	2	2	2	1	-	-	1			
CO3	2	2	2	1	1	1	1			
CO4	2	2	2	1	-	1	1			
CO5	2	2	2	1	-	1	1			
CO6	2	2	2	1	-	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	Lipschutz	Data Structures with 'C' (SIE) (Schaum's Outline Series)	McGraw Hill Education, New Delhi ISBN: 978-0070701984
2	Balgurusamy, E.	Data Structures using 'C'	McGraw Hill Education, New Delhi 2013, ISBN: 978-1259029547
3	ISRD Group	Data Structures using 'C'	McGraw Hill Education, New Delhi 2013, ISBN: 978-12590006401
4	Yashwant Kanetkar	Understanding Pointers in C	BPB ISBN 8170298911

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.javatpoint.com/data-structure-introduction	For All Content
2	https://www.geeksforgeeks.org/introduction-to-data-structures/	For All Content
3	https://studytonight.com/data-structures/	For All Content
4	https://www.tutorialspoint.com/data_structures_algorithms/	For All Content
5	https://www.w3schools.in/data-structures/	For All Content
6	https://www.mygreatlearning.com/blog/data-structure-tutorial-for-beginners/	For All Content
7	https://byjus.com/gate/introduction-to-data-structure-notes/	For 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

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Software Technology/ 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/ CST/ CW/ DS/ HA/ IF/ IH/ SE/ TE**
Semester	**: Third**
Course Title	**: DATABASE MANAGEMENT SYSTEM**
Course Code	**: 313302**

I. RATIONALE

This course focuses on fundamentals of relational database management system and enables students to design and manage database for various software applications. It also provides students with theoretical knowledge and practical skills in the use of databases and database management systems in Information Technology applications.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

To design database and use any RDBMS package as a backend for developing database applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Explain concept of database management system.
- CO2 - Design the database for given problem.
- CO3 - Manage database using SQL.
- CO4 - Implement PL/SQL codes for given application.
- CO5 - Apply security and backup methods on database.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313302	DATABASE MANAGEMENT SYSTEM	DMS	DSC	3	1	4	2	10	5	3	30	70	100	40	50	20	25#	10	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.
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 given database concept. TLO 1.2 Explain Overall structure of DBMS TLO 1.3 Describe architecture of database.	**Unit - I Introduction To Database System** 1.1 Database concepts:-Data, Database, Database management system, File system Vs DBMS, Applications of DBMS, Data Abstraction, Data Independence, Database Schema, The Codd's rules, Overall structure of DBMS 1.2 Architecture:- Two tier and Three tier architecture of database. 1.3 Data Models:- Hierarchical, Networking, Relational Data Models.	Presentations, Hands-on, Chalk-Board.
2	TLO 2.1 Explain relational structure of database. TLO 2.2 State types of keys with example. TLO 2.3 Draw ER diagrams for given problem. TLO 2.4 Explain different normalization forms.	**Unit - II Relational Data Model** 2.1 Relational Structure :- Tables (Relations), Rows (Tuples), Domains, Attributes, Entities 2.2 Keys :- Super Keys, Candidate Key, Primary Key, Foreign Key. 2.3 Data Constraints :- Domain Constraints ,Referential Integrity Constraints 2.4 Entity Relationship Model : - Strong Entity set, Weak Entity set, Types of Attributes, Symbols for ER diagram, ER Diagrams 2.5 Normalization:- Functional dependencies, Normal forms: 1NF, 2NF, 3NF	Presentations, Hands-on, Chalk-Board.

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 Write SQL queries using DDL, DML, DCL and TCL. TLO 3.2 Write SQL queries to join relations. TLO 3.3 Write SQL queries for ordering and grouping data. TLO 3.4 Use various class of operators in SQL. . TLO 3.5 Create schema objects for performance tunning.	**Unit - III Interactive SQL and Performance Tuning** 3.1 SQL: -Data-types, Data Definition Language (DDL), Data Manipulation language (DML), Data Control Language (DCL), Transaction Control Language (TCL). 3.2 Clauses & Join:- Different types of clauses - Where, Group by ,Order by, Having. Joins: Types of Joins, Nested queries. 3.3 Operators:- Relational, Arithmetic, Logical, Set operators. 3.4 Functions:- Numeric , Date and time, String functions, Aggregate Functions. 3.5 Views, Sequences, Indexes: -Views : Concept ,Create ,Update, Drop Views. Sequences :- Concept ,Create, Alter , Drop, Use of Sequence in table, Index: Concept ,Types of Index , Create ,Drop Indexes	Presentations, Hands-on, Chalk-Board.
4	TLO 4.1 Use control Structures in PL-SQL. TLO 4.2 Handle different types of exceptions. TLO 4.3 Explain various types of cursors. TLO 4.4 Create Procedure, Function on given problem. TLO 4.5 Explain types of triggers with examples	**Unit - IV PL/SQL Programming** 4.1 Introduction of PL/SQL: -Advantages of PL/SQL,The PL/SQL Block Structure, PL/SQL Data Types, Variable , Constant 4.2 Control Structure:- Conditional Control, Iterative Control, Sequential Control. 4.3 Exception handling: -Predefined Exception, User defined Exception. 4.4 Cursors:- Implicit and Explicit Cursors, Declaring, opening and closing cursor, fetching a record from cursor ,cursor for loops, parameterized cursors 4.5 Procedures:- Advantages, Create, Execute and Delete a Stored Procedure 4.6 Functions:- Advantages, Create, Execute and Delete a Function 4.7 Database Triggers :- Use of Database Triggers, Types of Triggers, Create Trigger, Delete Trigger	Presentations, Hands-on, Chalk-Board.
5	TLO 5.1 Implement SQL queries for database administration. TLO 5.2 Explain concept of various types database backup processes. TLO 5.3 Describe various terms related to advanced database concepts.	**Unit - V Database Administration** 5.1 Introduction to database administration:- Types of database users, Create and delete users, Assign privileges to users 5.2 Transaction: Concept, Properties & States of Transaction 5.3 Database Backup: Types of Failures, Causes of Failure, Database backup introduction, types of database backups: Physical & Logical 5.4 Data Recovery – Recovery concepts , recovery techniques- roll forward ,Rollback 5.5 Overview of Advanced database concepts:- Data Warehouse ,Data lakes , Data mining, Big data ,Mongo DB , DynamoDB,	Presentations, Hands-on, Chalk-Board.

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 database software	1	* Install the provided database software	2	CO1

DATABASE MANAGEMENT SYSTEM **Course Code : 313302**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Create Database schema for given application	2	*Note :- Ensure to Carry out following activities before creating database: - Draw ER diagram for given problem - Normalize the relation up to 3NF 1) Create Database for given application 2) Create tables for the given application 3)Assign Primary key for created table 4) Modify the table as per the application needs	4	CO1
LLO 3.1 Execute DDL Commands to manage database using SQL	3	* Write queries using DDL Statements for following operations – 1)Create, alter, truncate, drop ,rename table 2) Apply Key Constraints for suitable relation.	2	CO3
LLO 4.1 Execute DML Commands to manipulate data using SQL	4	* Write queries using DML Statements for following operations – 1) Select, Insert, delete, update, table 2) Apply Key Constraints for suitable relation.	2	CO3
LLO 5.1 Execute DCL Commands to control the access to data using SQL .	5	* Write queries using DCL Statements for following operations – 1)Grant, Revoke	2	CO3
LLO 6.1 Execute TCL Commands to control transactions on data using SQL .	6	* Write queries using TCL Statements for following operations – 1) Commit, Rollback, Savepoint	2	CO3
LLO 7.1 Implement Queries using Arithmetic operators	7	Write Queries using built-in Arithmetic operators.	2	CO3
LLO 8.1 Implement Logical operators to apply various conditions in query.	8	Apply built-in Logical operators on given data	2	CO3
LLO 9.1 Implement Relational operators to apply various conditions in query.	9	Apply built-in relational operators on given data	2	CO3
LLO 10.1 Write Queries to implement SET operations using SQL .	10	* Use following Set operators to perform different operations.	2	CO3
LLO 11.1 Execute queries using String functions	11	Write SQL Queries using built-in String functions	2	CO3
LLO 12.1 Execute queries using Arithmetic functions	12	Write SQL Queries using built-in Arithmetic functions	2	CO3
LLO 13.1 Implement queries using Date and Time functions	13	Write Queries using built-in Date and Time functions	4	CO3
LLO 14.1 Implement queries using Aggregate functions	14	Write Queries using SQL built-in Aggregate functions	2	CO3
LLO 15.1 Execute Queries for ordering and grouping data.	15	* Implement Queries Using different Where, Having, Group by, & Order by clauses .	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 16.1 Execute the queries based on Inner & outer join	16	* Implement SQL queries for Inner and Outer Join	2	CO3
LLO 17.1 Create and manage Views for faster access on relations.	17	* Create and Execute Views ,Seqeuence and Index in SQL.	4	CO3
LLO 18.1 Implement PL/SQL program using Conditional Statements	18	* Write a PL/SQL program using Conditional Statements- if, if then else ,nested if, if elseif else	2	CO4
LLO 19.1 Implement PL/SQL program using Iterative Statements	19	* Write a PL/SQL program using Iterative Statements- loop,for, do-while, while	2	CO4
LLO 20.1 Implement PL/SQL program using Sequential Control	20	Write a PL/SQL program using Sequential Control-switch, continue,goto	2	CO4
LLO 21.1 Create implicit & explicit cursors	21	* Write a PL/SQL code to implement implicit & explicit cursors	2	CO4
LLO 22.1 Implement PL/SQL program based on Exception Handling (Pre-defined exceptions)	22	* Write a PL/SQL program based on Exception Handling (Pre-defined exceptions)	2	CO4
LLO 23.1 Implement PL/SQL program based on Exception Handling (user defined exceptions)	23	* Write a PL/SQL program based on Exception Handling (user defined exceptions)	2	CO4
LLO 24.1 Create Procedures and stored procedures for modularity.	24	* Write a PL/SQL code to create Procedures and stored procedures	2	CO4
LLO 25.1 Create function for given database	25	* Write a PL/SQL code to create functions.	2	CO4
LLO 26.1 Implement triggers for given database.	26	* Write a PL/SQL code to create triggers for given database.	2	CO4
LLO 27.1 Implement SQL queries for database administration.	27	Execute DCL commands using SQL 1) Create Users 2) Grant Privileges to users 3)Revoke Privileges to users	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)

Self Learning

- Implement PL/SQL code for relevant topics suggested by the teacher.
- Complete any one course related to Database Management System on Infosys Springboard platform.

Assignment

- Solve an assignment on any relevant topic given by the teacher.

Micro project

- Develop a database for restaurant management system. The restaurant maintain catalogue for the list of food items and generate bill for the ordered food.
- Prepare Invoice management system for electricity bill generation. Accept meter reading as inputs and generate respective bill amount for the same.

- Design a database for registration and admission of patient for Hospital management system, draw ER diagram and normalize the database up to 3NF.
- Any topic suggested by 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.
- 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	Computer system - (Any computer system with basic configuration)	All
2	Any RDBMS software (MySQL/Oracle/SQL server/ or any other)	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction To Database System	CO1	6	4	6	2	12
2	II	Relational Data Model	CO2	8	2	4	6	12
3	III	Interactive SQL and Performance Tuning	CO3	12	2	6	10	18
4	IV	PL/SQL Programming	CO4	12	4	4	10	18
5	V	Database Administration	CO5	7	2	4	4	10
Grand Total				**45**	**14**	**24**	**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 term work.

Summative Assessment (Assessment of Learning)

- End semester examination, Lab performance, Viva voce

XI. SUGGESTED COS - POS MATRIX FORM

DATABASE MANAGEMENT SYSTEM **Course Code : 313302**

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			
CO2	2	2	3	2	1	2	1			
CO3	1	2	2	2	-	2	1			
CO4	1	3	3	2	1	3	2			
CO5	1	1	2	2	2	2	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	Henry F. Korth	Database System Concepts	McGraw Hill Education ISBN : 9780078022159
2	Ivan Bayross	SQL, PL/SQL – The Programming Language of Oracle	BPB Publication ISBN 10: 8170298997 BPB Publication ISBN 13: 9788170298991
3	ISRD Group	Introduction to Database Management Systems	McGraw Hill Education ISBN 10: 0070591199 McGraw Hill Education ISBN-13 : 978-0070591196

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://nptel.ac.in/courses/106105175	Data Base Management System
2	https://www.w3schools.com/sql/	SQL Tutorial
3	https://www.tutorialspoint.com/sql/index.htm	SQL Programming Language

Note :

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

Programme Name/s	**: Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science/ Electronics & Computer Engg.**
Programme Code	**: BD/ CM/ CO/ CST/ CW/ HA/ IF/ IH/ SE/ TE**
Semester	**: Third**
Course Title	**: OBJECT ORIENTED PROGRAMMING USING C++**
Course Code	**: 313304**

I. RATIONALE

In the modern world of Information Technology, Object Oriented Programming provides the most preferred approach for software development. It offers a powerful way to cope up with real world problems. C++ helps to develop fundamental understanding of object oriented concepts. This course enables to implement object oriented approach to solve a given programming problem.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Develop applications using concepts of OOP in C++.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Write C++ programs using classes and objects.
- CO2 - Develop C++ programs using constructors.
- CO3 - Implement Inheritance in C++.
- CO4 - Implement Polymorphism in C++.
- CO5 - Develop C++ programs to perform file operations.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313304	OBJECT ORIENTED PROGRAMMING USING C++	OOP	SEC	3	2	4	1	10	5	3	30	70	100	40	50	20	25@	10	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.
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 POP vs OOP approach of programming. TLO 1.2 Describe the different features of Object Oriented Programming. TLO 1.3 Write programs to solve arithmetic expressions. TLO 1.4 Write programs to demonstrate use of special operators in C++. TLO 1.5 Develop C++ program to show the use of Classes and Objects.	**Unit - I Principles of Object Oriented Programming** 1.1 Procedure Oriented Programming (POP) verses Object Oriented Programming (OOP) 1.2 Features of Object Oriented Programming, Examples of Object Oriented languages, Applications of OOP 1.3 Data types, Type compatibility, Declaration of variable, Dynamic initialization of variable, Reference variable, Type casting 1.4 Special Operators in C++: Scope resolution operator, Memory management operators, Manipulators 1.5 Structure of C++ program, Basic Input /Output operators and functions in C++, Simple C++ Program 1.6 Class & Object: Introduction, Specifying a class, Access specifiers, Defining member functions: Inside class and Outside class, Creating objects, Memory allocations for objects	Lecture Using Chalk-Board, Demonstration, Presentations, Hands-on, Flipped Classroom.
2	TLO 2.1 Develop a program using inline function. TLO 2.2 Develop friend function to solve given problem. TLO 2.3 Write C++ programs using array of objects. TLO 2.4 Write C++ program to initialize the object using constructor. TLO 2.5 Write C++ program to delete object using destructor.	**Unit - II Functions and Constructors** 2.1 Inline function, Static data members, Static member function, Friend function: Using two different classes , Using non-member function 2.2 Array of Objects, Object as function arguments 2.3 Concepts of Constructors, Types of constructors 2.4 Constructor overloading and Constructors with default arguments 2.5 Destructors	Lecture Using Chalk-Board, Demonstration, Presentations, Hands-on, Flipped Classroom.

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 Explain the given type of inheritance based on its characteristics. TLO 3.2 Implement given type of inheritance in C++ program. TLO 3.3 Write C++ program using virtual base class. TLO 3.4 Use constructor in given derived class.	**Unit - III Extending classes using Inheritance** 3.1 Introduction to Inheritance, Defining a derived class, Visibility modes and effects 3.2 Types of Inheritance : Single, Multilevel, Multiple, Hierarchical, Hybrid 3.3 Virtual base class, Abstract class, Constructor in derived class	Lecture Using Chalk-Board, Demonstration, Presentations, Hands-on, Flipped Classroom.
4	TLO 4.1 Create C++ program to perform given arithmetic operations using pointers. TLO 4.2 Use 'pointer to object' to solve the given problem. TLO 4.3 Use compile time polymorphism to solve the given problem. TLO 4.4 Use run time polymorphism to solve the given problem.	**Unit - IV Pointers and Polymorphism in C++** 4.1 Concept of Pointer: Pointer declaration, Pointer operator, Address operator, Pointer arithmetic 4.2 Pointer to Object: Pointer to object, 'this' pointer, Pointer to derived class 4.3 Introduction of Polymorphism, Types of polymorphism 4.4 Compile time Polymorphism: Function overloading, Revision of constructor overloading, Operator overloading: Rules for operator overloading, Overloading of unary and binary operators 4.5 Run time polymorphism: Virtual function, Rules for virtual function, Pure virtual function	Lecture Using Chalk-Board, Presentations, Demonstration, Hands-on, Flipped Classroom.
5	TLO 5.1 Identify relevant class to perform the given file operations. TLO 5.2 Describe different file modes. TLO 5.3 Develop C++ program to perform read/write operations from/to the given file.	**Unit - V File operations** 5.1 C++ stream classes, Classes for file stream operations 5.2 Detection of end of file, File modes 5.3 Opening files: Using constructors and open(), Closing files, Reading from and writing to files, Formatted Input/output functions in file 5.4 Types of file: Random access, Sequential access	Lecture Using Chalk-Board, Presentations, Demonstration, Hands-on, Flipped Classroom.

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 Develop program to evaluate expressions using various operators and Input/output functions.	1	*Write programs to evaluate any expression using Input / Output functions	2	CO1
LLO 2.1 Develop C++ program using special type of operators.	2	*Write programs using- • Scope resolution operator • Memory management operator • Manipulators	4	CO1
LLO 3.1 Develop programs to implement type casting.	3	Write programs to demonstrate use of- • Implicit type casting • Explicit type casting	2	CO1
LLO 4.1 Implement classes and objects to define the function inside class.	4	Write programs to show use of classes and objects to define the function inside the class	2	CO1
LLO 5.1 Implement classes and objects to define the function outside class.	5	*Write programs to define the function outside the class	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Implement programs using inline function.	6	*Write programs to implement inline function	2	CO2
LLO 7.1 Implement friend function using different classes. LLO 7.2 Implement friend function using external function.	7	*Write programs to implement friend function using- • Two different classes • External function	2	CO2
LLO 8.1 Develop program using static data member. LLO 8.2 Develop program using static member function.	8	*Write programs to implement- • Static data member • Static member function	2	CO2
LLO 9.1 Implement programs to show the use of array of objects.	9	*Write programs to create array of objects	2	CO2
LLO 10.1 Implement the concept of constructor and destructor.	10	*Write programs for- • Default constructor • Parameterized constructor • Copy constructor • Multiple constructor in one class	4	CO2
LLO 11.1 Implement Single level inheritance. LLO 11.2 Implement multilevel inheritance.	11	Write programs using- • Single level inheritance • Multilevel inheritance	2	CO3
LLO 12.1 Develop program using multiple inheritance.	12	*Write programs to implement multiple inheritance	2	CO3
LLO 13.1 Develop program using hierarchical inheritance.	13	Write programs to implement hierarchical inheritance	2	CO3
LLO 14.1 Implement virtual base class in a program.	14	*Write programs to implement virtual base class.	2	CO3
LLO 15.1 Implement constructors in derived class in a program.	15	Write programs which show the use of constructors in derived class	2	CO3
LLO 16.1 Implement pointer arithmetic in a program. LLO 16.2 Implement pointer to object in a program. LLO 16.3 Implement 'this' pointer in a program.	16	*Write programs to implement- • Pointer to object • 'this' pointer	2	CO4
LLO 17.1 Implement program to use pointer to derived class.	17	*Write programs for- • Pointer to derived class in single inheritance • Pointer to derived class in multilevel inheritance	4	CO4
LLO 18.1 Implement function overloading in a program.	18	Write programs which show the use of function overloading	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 19.1 Implement unary operator overloading using member function. LLO 19.2 Implement unary operator overloading using friend function.	19	*Write programs to overload unary operator using- • Member function • Friend function	4	CO4
LLO 20.1 Implement binary operator overloading using member function. LLO 20.2 Implement binary operator overloading using friend function.	20	Write programs to overload binary operator using- • Member function • Friend function	2	CO4
LLO 21.1 Develop program using virtual function.	21	*Write programs to implement virtual function	2	CO4
LLO 22.1 Develop program using pure virtual function.	22	Write programs to implement pure virtual function	2	CO4
LLO 23.1 Implement read and write operations from/to file using constructor. LLO 23.2 Implement read and write operations from/to file using open().	23	*Write programs to read and write from/to file using- • Constructor • open()	2	CO5
LLO 24.1 Use formatted Input / Output functions to format the contents.	24	*Write programs to copy the content of one file into another file using formatted input/output functions	2	CO5
LLO 25.1 Implement get() and put() functions on file.	25	Write file programs to implement sequential input and output operations on file	2	CO5
LLO 26.1 Implement input/ output operations on binary file.	26	Write programs to perform input / output operations on binary files	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

- Develop Student Grading System. Accept student data and marks for 5 subjects for 5 students. Calculate the percentage and finalize grade awarded to the student. Write the records in to file.
- Develop Quiz Management System. Quiz should accept student credentials and contain 10 MCQ type questions. Determine the final result. Save the result in file along with student credentials.
- Develop advanced calculator for the following function: Binary to Decimal, Decimal to Binary etc..
- Develop Hotel Management Application. It should accept room reservation for 10 rooms. Find number of empty rooms. Display relevant information and write maximum 5 records into file.
- Develop Employee Management System using Inheritance. Collect following information from user: Employee_ID ,Employee_Name, Basic_Salary, Leave taken in the month Calculate Net Salary assuming applicable deductions and display. Write maximum 5 records into file.
- Any other micro project as suggested by subject faculty.
- For all the Microprojects :design and implement the system independently.. Then, use an AI tool to generate a solution for the same problem and compare both programs. Submit your program, AI-generated solution, comparison, and a brief reflection on the same

Assignment

- Solve assignment covering all COs given by teacher

Other

- Complete the course object oriented concepts using C++ on Infosys Springboard

Self learning

- Use Git and GitHub for maintaining versions of C++ programs/Microproject.

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	Computer System (Any computer system with basic configuration)	All
2	“C++” Compiler (Any)	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	Principles of Object Oriented Programming	CO1	8	2	4	6	12
2	II	Functions and Constructors	CO2	12	2	4	10	16
3	III	Extending classes using Inheritance	CO3	9	2	4	10	16
4	IV	Pointers and Polymorphism in C++	CO4	10	2	4	10	16
5	V	File operations	CO5	6	0	4	6	10
Grand Total				**45**	**8**	**20**	**42**	**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 and 40% weightage to product
- A continuous assessment-based term work

Summative Assessment (Assessment of Learning)

- End semester examination, Lab performance, Viva voce

XI. SUGGESTED COS - POS MATRIX FORM

OBJECT ORIENTED PROGRAMMING USING C++ **Course Code : 313304**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	1	1	2	1	1	1			
CO2	2	1	1	2	1	1	1			
CO3	2	2	2	2	2	2	1			
CO4	2	2	2	2	2	2	1			
CO5	2	2	2	2	2	2	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	E Balaguruswamy	Object Oriented Programming with C++	McGraw-Hill Education ISBN-10:0070669074, ISBN-13:9780070669079
2	D Ravichandran	Programming with C++	McGraw-Hill Education ISBN-10: 0070681899, ISBN-13: 978-0070681897
3	Stroustrup B.	The C++ Programming Language	Pearson Education New Delhi ISBN-10: 0275967301, ISBN-13: 978-0275967307
4	Robert Lafore	Object Oriented Programming in C++	Pearson Education India ISBN-10: 8131722821, ISBN-13: 978-8131722824

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.w3schools.com/cpp/	C++ Tutorial for all topics
2	https://www.javatpoint.com/cpp-tutorial	C++ Tutorial for all topics
3	https://www.javatpoint.com/cpp-files-and-streams	C++ File Streams
4	https://www.programiz.com/cpp-programming	Inheritance in C++
5	https://www.programiz.com/cpp-programming/online-compiler/	Online Compiler for C++
6	https://www.onlinegdb.com/online_c++_compiler	Online compiler for C++

Note :

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

DIGITAL TECHNIQUES AND MICROPROCESSORS **Course Code : 313305**

Programme Name/s	**: Cloud Computing and Big Data/ Information Technology/ Computer Science & Information Technology**
Programme Code	**: BD/ IF/ IH**
Semester	**: Third**
Course Title	**: DIGITAL TECHNIQUES AND MICROPROCESSORS**
Course Code	**: 313305**

I. RATIONALE

It is essential to know the basics of digital techniques for understanding the applications of digital systems as well as microprocessors. Microprocessors serve as the heart of computer systems, and understanding their architecture is crucial for appreciating how computers process information. Microprocessors play a key role in embedded systems and Internet of Things (IoT) devices, making this course highly relevant for contemporary applications in IT. This course will help the student to comprehend logic and circuit design and enable them to perform assembly language programming for microprocessors, cultivating the skills essential for logic and software development in the IT sector.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

This course aims to help the student to attain the following industry identified outcomes through various teaching-learning experiences:
Test digital systems by applying principles of digital techniques and microprocessors.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Test logic gates and digital systems.
- CO2 - Use basic combinational and sequential logic circuits employing digital ICs.
- CO3 - Perform operations on registers using 8086 instructions.
- CO4 - Use 8086 microprocessor environment to build and execute assembly language programs.
- CO5 - Develop assembly language programming in 8086 to implement loops and branching instructions.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313305	DIGITAL TECHNIQUES AND MICROPROCESSORS	DTM	AEC	3	-	2	1	6	3	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 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 Convert the given number system to the specified number system. TLO 1.2 Convert given form of code to another code. TLO 1.3 Apply arithmetic operations on the number belongs to given number system. TLO 1.4 Derive the truth table of the given basic logic gates / derived logic gates. TLO 1.5 Design the logical circuit for the given application.	**Unit - I Number Systems and Digital Logic Gates** 1.1 Terms - Bit, Byte, Nibble, Word 1.2 Number systems- Decimal, Binary, Octal, Hexadecimal and their conversions from one number system to another 1.3 Codes and code conversion: BCD, GRAY, ASCII, EBCDIC 1.4 Binary, Hexadecimal, BCD arithmetic and 1's and 2's complement (up to 8 bit) 1.5 Basic logic gates(AND,OR,NOT), universal gates (NAND,NOR), special gates (EX-OR, EX-NOR), and their truth table, basic gates using universal gates 1.6 Basic logic operations using laws of Boolean algebra, De-Morgan's theorems	Classroom Learning Flipped Classroom Collaborative Learning Use of logic simulator like Virtual Labs, online converters etc
2	TLO 2.1 Explain concept of Sum-of- Product (SOP) and Product-of-Sum(POS). TLO 2.2 Explain concept of half-full adder / half-full subtractor using K-MAP. TLO 2.3 Construct the logical diagrams using multiplexer / demultiplexer ICs to solve the given expression. TLO 2.4 State the use of latch, flipflop, counter, buffer.	**Unit - II Combinational and Sequential Logic Circuits** 2.1 Standard/canonical forms for Boolean functions, Min-terms and Max-terms, Minimization of expression using SOP-POS and K-MAP, simplification of expression of half adder/full adder and half/full subtractor using K-MAPs 2.2 Concept of multiplexer and demultiplexer, logical diagram development using multiplexer/ demultiplexer ICs 2.3 Multiplexer tree and demultiplexer tree, applications of multiplexers and demultiplexers 2.4 Clock signal, flipflop, latches, counter, buffer and tri-state buffer (only concept)	Lecture Using Chalk-Board Flipped Classroom Collaborative Learning Virtual Lab

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 Enlist features of 8086 microprocessor. TLO 3.2 Calculate physical address to locate the given data from memory segmentation. TLO 3.3 Explain given blocks of architecture of 8086 microprocessor. TLO 3.4 Compare minimum mode and maximum mode of 8086 features.	**Unit - III 16-Bit Microprocessor 8086** 3.1 Microprocessor 8086 features, pin diagram description and architecture of 8086 3.2 Units of 8086: Bus interface unit and execution unit, concept of memory segmentation and pipelining, physical address generation 3.3 Flag register of 8086, segment registers, index register, ALU-arithmetic logic unit 3.4 Minimum mode and maximum mode configuration of 8086, timing diagrams concept	Classroom Learning Flipped Classroom Cooperative Learning
4	TLO 4.1 Identify relevant addressing mode of instruction. TLO 4.2 Choose relevant instruction to perform the given operation from the instruction set of 8086. TLO 4.3 Use data transfer and arithmetic instruction for given situation employing specific addressing mode. TLO 4.4 Use logical and flag manipulation instruction for given situation employing specific addressing mode.	**Unit - IV Basic assembly Language Programming using 8086** 4.1 Programming model of 8086 assembly language program assembler directives 4.2 Addressing modes of 8086, register, direct, based, indexed, based-indexed addressing, assembler directives 4.3 Format of instruction, instruction set: data transfer, arithmetic, logical, branch and loop, flag manipulation 4.4 Shift and rotate instructions, string instructions	Classroom Learning Collaborative Learning Flipped Classroom Program development tools and simulators
5	TLO 5.1 Develop the assembly language program to solve the given problem using looping. TLO 5.2 Develop the assembly language program to solve the given problem using branching structure.	**Unit - V Assembly Language Programming using Loops and Branching instructions** 5.1 Assembly language programs for addition, subtraction, multiplication, division on hexadecimal, BCD numbers (8/16 bit) 5.2 Assembly language programs using decision making 5.3 Assembly language programs using looping and branching structure. assembly language programs for sorting, searching and block transfer (with string and without string instructions) of given numbers 5.4 Assembly language programs for uppercase to lowercase, lowercase to uppercase, conversion of hexadecimal to BCD and BCD to hexadecimal	Classroom Learning Flipped Classroom Collaborative Learning Program development tools and simulators

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify various logic gate ICs. LLO 1.2 Verify truth tables of basic logic gates (AND-7408, OR- 7432, NOT-7404) using breadboard LLO 1.3 Verify truth tables of universal gates (NAND-7400, NOR-7402). LLO 1.4 Verify truth tables of special logic gates EX-OR-7486, EX-NOR-74266	1	* Verification of truth table of basic logic gates, special logic gates and Identify various Logic gate ICs.	2	CO1

DIGITAL TECHNIQUES AND MICROPROCESSORS **Course Code : 313305**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Design a circuit for a given logical expression using the universal gates (NAND) LLO 2.2 Design a circuit for a given logical expression using the universal gates (NOR).	2	Implementation and verification of expression using universal logic gate ICs	2	CO1
LLO 3.1 Verify the truth table of De-Morgan's first theorem using basic logic gates. LLO 3.2 Verify the truth table of De-Morgan's second theorem using basic logic gates..	3	Verification of De-Morgan's theorems using basic logic gates	2	CO2
LLO 4.1 Design and test the circuit for converting expression into Sum-of-Product(SOP) LLO 4.2 Design and test the circuit for converting expression into product (POS).	4	* Conversion of expression to Sum-of-Product (SOP) and Product-of-Sum (POS)	2	CO2
LLO 5.1 Design a Combinational Circuit using Multiplexer IC-74LS153 (4:1 MUX). LLO 5.2 Design a Combinational Circuit using Demultiplexer IC -74139.	5	* Implement Multiplexer and Demultiplexer logic (The practical may be performed using virtual lab)	2	CO2
LLO 6.1 Verify states of the Latch using IC 74373.	6	Implementation of Latch	2	CO2
LLO 7.1 Develop an assembly language program to verify the contents of general purpose, segment registers, flags and contents of memory locations of segments	7	* Verification of contents of general purpose, segment registers, flags and memory locations of different segments during execution of the program	2	CO3
LLO 8.1 Develop an assembly language program to add 8 bit and 16-bit signed/ unsigned hexadecimal numbers. LLO 8.2 Develop an assembly language program to Subtract two 8-bit and 16-bit signed/ unsigned hexadecimal numbers.	8	* Assembly language programming for addition and subtraction for hexadecimal numbers	2	CO4
LLO 9.1 Develop an assembly language program to add 8 bit and 16-bit BCD numbers. LLO 9.2 Develop an assembly language program to subtract two 8-bit and 16-bit BCD numbers.	9	Apply assembly language programming logic for addition, subtraction and multiplication for BCD numbers.	2	CO4
LLO 10.1 Develop assembly language programming for multiplication and division.	10	* Assembly language programming for multiplication and division	2	CO4
LLO 11.1 Develop assembly language programming for finding smallest /largest hexadecimal numbers.	11	Assembly language programming to find smallest /largest hexadecimal numbers	2	CO4
LLO 12.1 Develop an assembly language program to Sort numbers of given arrays in ascending order. LLO 12.2 Develop an assembly language program to Sort numbers of a given array in descending order.	12	* Assembly language programming for sorting of data	2	CO5
LLO 13.1 Develop assembly language programming for transfer of block of data.	13	Assembly language programming for transfer of block of data	2	CO5
LLO 14.1 Apply assembly language programming logic for counting the occurrence of a given number.	14	Count the occurrence of a given number from a block of data	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Develop an assembly language program to shift given hex number to the left / right(with and without carry). LLO 15.2 Develop an assembly language program to rotate given hex number to the left / right(with and without carry).	15	* Implement shift and rotate instructions on given data	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

- Find the factorial of a given number using 8086 assembly language programming.
- Separate odd and even numbers from a given array using an assembly language program.
- Design shift register using JK Flipflop.
- Design a Burglar alarm using electronic components and digital ICs.

Assignment

- Write an assembly language program using 8086 to generate the Fibonacci series.
- Draw and implement the circuit on the breadboard for 1:16 DEMUX using 1:8 DEMUX. State the ICs used along with their description.

Self Learning Activity

- Develop an assembly language program to add 8-bit and 16-bit Unsigned numbers (using procedure).
- Write an assembly language program to add and subtract two BCD numbers(using MACRO).
- Write an ALP to multiply two BCD numbers (using MACRO).

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

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	1) Digital Multimeter: 3 and 1/2 digit 2) Pulse Generator/Function Generator: TTL Pulse Generator 20mA per Channel(max), 0 to 5.0 V (max) 3) DC Regulated Power Supply: 2 x 0-30 V; 0-2 A Automatic Overload (Current Protection) Constant Voltage and Constant Current Operation Digital Display for Voltage and Current Adjustable Current Limiter Excellent Line and Load Regulation 4) Basic logic gates (AND-7408, OR- 7432, NOT- 7404), Universal gates (NAND-7400, NOR-7402) EX-OR-7486, EX-NOR-74266 5) 4:1 Multiplexer IC-74LS153 6) Demultiplexer IC -74139 7) Bread boards, connecting wires, Stripper, Soldering Gun, Soldering Metal, Flux, IC Tester, LEDs, Digital ICs, Data sheets of ICs used in Lab.	1,2,3,4,5,6
2	1) Personal Computer Intel Pentium Onwards Minimum 2GB RAM. 500Gbyte HDD) installed with Windows 2000 onwards 2) Any Editor to write/edit programs 3) Turbo/Macro Assembler (TASM / MASM) 4) Turbo Linker (TLINK/LINK 5) Turbo Debugger (ID/Debug), (DOSBOX utility for higher-end operating systems) (Minimum 20 computers for a batch of 20 students) with the shared printer. 8086 freeware/open source based simulator to demonstrate internal functioning of microprocessor (Desirable)	8,10,9,11,13,12,14,15,7

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	Number Systems and Digital Logic Gates	CO1	8	2	4	6	12
2	II	Combinational and Sequential Logic Circuits	CO2	10	2	8	6	16
3	III	16-Bit Microprocessor 8086	CO3	8	2	4	6	12
4	IV	Basic assembly Language Programming using 8086	CO4	10	4	6	6	16
5	V	Assembly Language Programming using Loops and Branching instructions	CO5	9	2	6	6	14
Grand Total				**45**	**12**	**28**	**30**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks and average of two unit test.
- For formative assessment of Laboratory learning 25 marks marks will be consider for out of 30 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	2	1	1	1	-	1	1			
CO2	2	1	2	2	-	1	1			
CO3	2	-	-	1	-	-	1			
CO4	2	1	2	2	-	1	1			
CO5	2	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	Jain R.P.	Modern Digital Electronics	McGraw Hill Education , New Delhi, 2016, ISBN: 978-0070669116
2	Leach Donald P., Malvino Albert Paul, Saha Gautam	Digital Principles and Applications 5/E	Tata McGraw Hill Education, New Delhi, ISBN: 978-0028018218
3	Savaliya M. T.	8086 Programming and advanced processor architecture	Wiley India New Delhi, 2013, ISBN: 978-8126530915
4	Bhurchandi K. M., Roy A. K.	Advanced microprocessors and peripherals 3/E	Tata McGraw Hill Education, New Delhi, 2016, ISBN:9781259006135
5	Triebel, Walter, Singh A., Avtar	The 8088 and 8086 Microprocessors	SCITECH Publications, Chennai 2015, ISBN:978-8183717021

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://dld-iitb.vlabs.ac.in/	Virtual Lab IIT, Bombay
2	https://www.falstad.com/circuit/	Paul Falstad Circuit Simulator
3	https://logic.ly/	Online Simulator for Digital Techniques
4	https://cse15-iiith.vlabs.ac.in/	Virtual Lab IIT, Delhi

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