Programme Name/s	**: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Hotel Management & Catering Technology/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Medical Electronics/ Production Engineering/ Printing Technology/ Polymer Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures/**
Programme Code	**: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MU/ 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.

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

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
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

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 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.

-

- 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

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

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
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

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Sr.No	Link / Portal	Description
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

DATA STORY TELLING AND VISUALIZATION **Course Code : 313004**

Programme Name/s : **Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Data Sciences**
Programme Code : **AI/ AN/ DS**
Semester : **Third**
Course Title : **DATA STORY TELLING AND VISUALIZATION**
Course Code : **313004**

I. RATIONALE

Effective data storytelling and Visualization can have a positive impact on people and organization. This course enables students to construct data stories, extract meaningful data and represent data for effective visualization so that the audience will be engaged with the content and make critical decisions quicker and more confidently. Data StoryTelling and Visualization builds Business Analysis skills in diploma students to fill the gap between sophisticated data analyses and decision-makers who might not have the skills to interpret the data.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Extract valuable insights from complex data set to engage stakeholders, enhance decision-making and achieve business outcomes.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify the characters in data storytelling.
- CO2 - Eliminate clutter to grab audience attention.
- CO3 - Construct Storytelling for the given incident.
- CO4 - Transform Data to Visuals.
- CO5 - Create data visualization using many distributions.

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	
313004	DATA STORY TELLING AND VISUALIZATION	DST	DSC	2	-	2	-	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

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 State the importance of context. TLO 1.2 Differentiate between exploratory and explanatory analysis. TLO 1.3 Identify the audience. TLO 1.4 Compose a 3 minute story. TLO 1.5 Choose an effective visual effect of data storytelling.	**Unit - I Introduction to Data StoryTelling** 1.1 Concept / Importance of Context 1.2 Exploratory vs. explanatory analysis 1.3 Who - Your audience, You, What – Action, Mechanism, Tone, How, Example 1.4 What is Data Story, make a figure for the generals 1.5 The 3-minute story, Big Idea, Storyboarding. 1.6 Visual effects of Data Story Telling -Choosing an effective visual - Simple text, Tables, Graphs, Points, Bars - Vertical bar chart, Horizontal bar chart	Presentations Lecture Using Chalk-Board Case Study Video Demonstrations
2	TLO 2.1 Interpret clutter and cognitive load. TLO 2.2 Use Gestalt principles of visual perception. TLO 2.3 Implement Decluttering steps. TLO 2.4 Represent Pre-attentive attributes in text, graphs, page.	**Unit - II Cluttering and Decluttering** 2.1 Clutter is our enemy - Cognitive load, Clutter 2.2 Introduction to Gestalt principles of visual perception 2.3 Decluttering: step-by-step 2.4 Focus audience's Attention – Pre-attentive attributes signal where to look 2.5 Pre-attentive attributes in text and graphs : Size, Color, Position on page	Presentations Demonstration Case Study
3	TLO 3.1 Interpret Affordances, Accessibility, Aesthetics and Acceptance. TLO 3.2 Illustrate dissecting model visuals. TLO 3.3 Compile data to construct data storytelling.	**Unit - III The process of Storytelling** 3.1 Think like a designer-Affordances, Accessibility, Aesthetics, Acceptance 3.2 Dissecting model visuals - line graph, 100% stacked bars 3.3 Lessons in storytelling - The magic of story, Constructing the story, The narrative structure, The power of repetition, Tactics to help ensure that your story is clear 3.4 Pulling it all together for data storytelling 3.5 Final Thoughts - Where to go from here, Building storytelling with data competency in your team or organization	Demonstration Presentations Case Study Flipped Classroom
4	TLO 4.1 Interpret Ugly, Bad, and Wrong Figures. TLO 4.2 Map data onto aesthetics. TLO 4.3 Visualize data using Coordinate Systems and Axes. TLO 4.4 Represent data set using Bar Plots. TLO 4.5 Visualize amounts using various plots.	**Unit - IV Data Visualization** 4.1 Introduction: Ugly, Bad, and Wrong Figures 4.2 Visualizing Data: Mapping Data onto Aesthetics 4.3 Coordinate Systems and Axes 4.4 Directory of Visualizations 4.5 Visualizing Amounts - Bar Plots 4.6 Visualizing Distributions - Histograms and Density Plots. Empirical Cumulative Distribution Functions and Q-Q Plots	Hands-on Demonstration Case Study Cooperative Learning

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Visualize many distributions along the axes. TLO 5.2 Represent Proportions with the help of case studies. TLO 5.3 Describe Titles, Captions, and Tables. TLO 5.4 Select appropriate Visualization Software and Image file formats. TLO 5.5 Explore freely available Data Visualization Tools.	**Unit - V Visualizing Distributions and Proportions** 5.1 Visualizing Many Distributions at Once 5.2 Visualizing Distributions Along the Vertical Axis and Horizontal Axis 5.3 Visualizing Proportions: A Case for Pie Charts and Side-by-Side Bars 5.4 Titles, Captions, and Tables 5.5 Choosing the Right Visualization Software and Image file formats 5.6 Exploring free Data Visualization Tools for e.g. Tableau, Microsoft Power BI, Google Data Studio and Openheatmap	Demonstration Presentations Case Study Chalk-Board 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 Identify the audience. LLO 1.2 Interpret the need of the Audience.	1	Identify a project you are working on where you need to communicate in a data-driven way. Reflect upon and write the answers to the following questions. i) Who is your Audience? ii) What does your audience care about? iii) What action does your audience need to take?	2	CO1
LLO 2.1 Identify the Stake. LLO 2.2 Design the big idea.	2	*Identify a project you are working on where you need to communicate in a data-driven way. Reflect upon and write the answers of following questions. a) What is a Stake? i) What are the benefits if your audience acts in the way that you want them to? ii) What are the risks if they do not? b) Form a Big Idea i) Articulate your point of view. ii) Convey what's at stake. iii) Be a complete (and single) sentence.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Construct a data story on given incident. LLO 3.2 Determine the audience, communication mechanism, and desired tone. LLO 3.3 Decide effective Visuals.	3	*Determine audience, communication mechanism,desired tone and Select effective Visuals for any incident *(Below is an example for reference only).Teacher shall allocate similar assignments.* i) Who is your Audience? ii) List the primary groups or individuals to whom you'll be communicating. iii) If you had to narrow that to a single person, who would that be? iv) What does your audience care about? v) What action does your audience need to take? *Example: Buses Bunching - Make a data story on bus bunching, (Bus Bunching means when a bus gets delayed and later causes multiple buses to arrive at a single stop at the same time.*	2	CO1
LLO 4.1 Construct a data story on given incident. LLO 4.2 Perform decluttering. LLO 4.3 Choose suitable pre attentive attributes. LLO 4.4 Determine feasibility as per designer's view.	4	*Make a clutter free Data Story on any incident. i) Identify and eliminate clutter. ii)Select suitable pre-attentive attributes. iii)Explore affordances, accessibility, and aesthetics as per designers view.	2	CO2 CO3
LLO 5.1 Compose a Video for Data Storytelling.	5	Create a simple video (up to 3 minutes) telling a story on incidence given in Practical no.3.	2	CO1 CO2 CO3

DATA STORY TELLING AND VISUALIZATION **Course Code : 313004**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Construct a data story on given incident. LLO 6.2 Record the Observations of the given data story.	6	*Create a data story for Vehicle(Bicycle/Bike/Car/Bus etc.) Rental System. *(Below is an example for reference only).Teacher shall allocate similar assignments.* *Example: Create a data story with respect to the following observations:* *i)What are the most popular pick-up locations across the city for Citi Bike rental?* *ii)How does the average trip duration vary across different age groups, and over time?* *iii)Which age group rents the most bikes?* *iv)How does bike rental vary across the two user groups (one-time users vs. long-term subscribers) on different days of the week?* *v)Do factors like weather and user age impact the average bike trip duration?*	2	CO1 CO2 CO3
LLO 7.1 Narrate the Data story by composing a video consisting of various visual props.	7	*Create a video (up to 5 minutes) telling a story on given Incidence. Record a video of yourself speaking, or narrate while showing visual props or sketches, or screencast a PowerPoint presentation, etc. Choose how you present the story. Produce a single video file (formatted as a .mov file) *Teacher shall suggest various incidents to the students.*	2	CO1 CO2 CO3
LLO 8.1 Create a bar chart from the recorded data.	8	Create a bar chart for data visualizations on Practical No. 6.	2	CO1 CO2 CO3
LLO 9.1 Explore Real life example of storytelling of any Musical/Social App.	9	*Construct a Case study on data storytelling for any Musical/Social App. *Example: Spotify takes the data from our listening habits and spins it into an exciting audio and visual experience.Teacher shall allocate similar case study.*	2	CO2 CO3 CO4
LLO 10.1 Write a python program for data cleaning.	10	*Implementation of a python program that performs data cleaning on any dataset.	2	CO2 CO3 CO4
LLO 11.1 Plot a Histogram using Single Distribution.	11	Create Bar chart for data visualization using Single distribution. *Example: Histogram of the ages of the train/flight passengers.Teacher shall allocate similar assignments.*	2	CO4 CO5
LLO 12.1 Create worksheet using Visualization tool.	12	Develop a worksheet, add filters and create chart using dataset by using any Visualization tool.	2	CO4 CO5
LLO 13.1 Create Histogram using Many Distribution.	13	* Create Bar chart for data visualization using Many distribution. *Example: Histogram of the gender and ages of the train/flight passengers.Teacher shall allocate similar assignments.*	2	CO4 CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Perform dataset loading to plot grouped bars. LLO 14.2 Write a python program to create grouped bars from the loaded data.	14	Implementation of a python program that loads a dataset and plot grouped bars.	2	CO3 CO4 CO5
LLO 15.1 Perform dataset loading to plot a pie chart. LLO 15.2 Write a python program to create pie chart from the loaded data.	15	Implementation of a python program that loads any dataset and plot a pie chart.	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) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Hardware: Personal computer, (i3-i5 preferable), RAM minimum 4 GB onwards	All
2	Operating system: Windows 7 onwards	All
3	Software: Python IDE, Video Makers/Editors, Visualization tools	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 StoryTelling	CO1	4	0	0	0	0
2	II	Cluttering and Decluttering	CO2	6	0	0	0	0
3	III	The process of Storytelling	CO3	6	0	0	0	0
4	IV	Data Visualization	CO4	7	0	0	0	0
5	V	Visualizing Distributions and Proportions	CO5	7	0	0	0	0
Grand Total				**30**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Each Practical will be assessed considering 60% weightage to the process, 40% weightage to the product.

Summative Assessment (Assessment of Learning)

- End Semester Exam based on Practical performance and 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	1	2	-	-	-	-	-			
CO2	1	2	1	1	-	-	-			
CO3	1	2	1	2	1	1	1			
CO4	1	3	2	2	1	1	1			
CO5	1	3	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	Cole Nussbaumer Knaflic	Storytelling with data – a data visualization guide for business professionals	Cole Nussbaumer Knaflic Wiley ISBN: 978-1-119-00225-3
2	Claus O. Wilke	Fundamentals of Data Visualization	O'Reilly ISBN:978-1-492-03108-6.
3	Kenneth A Lambert, B.L. Juneja	Fundamentals of PYTHON	CENGAGE Learning, ISBN:978-81-315- 2903-4

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://nptel.ac.in/courses/106106182	30 hours course for Python which teaches how to practice and culture the art of programming with Python as a language.
2	https://careerfoundry.com/en/tutorials/data-analytics-for-beginners/storytelling-with-data/	A step-by-step tutorial for data storytelling.
3	https://blog.hubspot.com/marketing/great-data-visualization-examples	A guide that offers applicable ways to ensure your data visualization is effective, and provide examples for inspiration along the way.
4	https://www.udemy.com/course/mastering-the-art-of-data-visualization-2020/	Online course with certification that Unlock the Power of Data Visualization and Analytics to Drive Data-Driven Insights.
5	https://online.hbs.edu/blog/post/data-visualization-tools	Top data visualization tools with navigation links for business professionals by Harvard Business School.

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 Science & Engineering/ Data Sciences/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science/ Electronics & Computer Engg./**
Programme Code	**: AI/ AN/ BD/ CM/ CO/ CW/ DS/ HA/ IF/ IH/ SE/ TE**
Semester	**: 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	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Instrumentation & Control/ Industrial Electronics/ Instrumentation/ Medical Electronics/ Computer Science/ Electronics & Computer Engg.**
Programme Code	**: AI/ AN/ AO/ CM/ CO/ CW/ DE/ DS/ EJ/ EK/ ET/ EX/ HA/ IC/ IE/ IS/ MU/ SE/ TE**
Semester	**: Third**
Course Title	**: DIGITAL TECHNIQUES**
Course Code	**: 313303**

I. RATIONALE

Digitization implies use of digital circuits in most of automation and industrial systems. The knowledge of logic gates, combinational and sequential circuits using discrete gates and digital ICs will enable students to interpret working of digital equipment and test their functionality.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to attain the following industry/employer expected outcome through various teaching learning experiences:
Student will able to test the functionality of the digital circuits/system.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Apply number system and codes concept to interprete working of digital systems.
- CO2 - Apply Boolean laws to minimize complex Boolean function.
- CO3 - Develop combinational logic circuits for given applications.
- CO4 - Develop sequential logic circuits using Flip-flops.
- CO5 - Interpret the functions of data converters and memories in digital electronic systems.

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	
313303	DIGITAL TECHNIQUES	DTE	DSC	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 from one number system to another number system. TLO 1.2 Perform arithmetic operations on binary numbers. TLO 1.3 Subtract given binary numbers using 1's and 2's compliment method. TLO 1.4 Convert the given coded number into the other specified code. TLO 1.5 Write the application of the given code. TLO 1.6 Perform BCD addition and subtraction for the given Decimal numbers .	**Unit - I Number Systems** 1.1 Number Systems: Types of Number Systems (Binary, Octal, Decimal, Hexadecimal), conversion of number systems 1.2 Binary Arithemetic: Addition, Subtraction, Multiplication and Division 1.3 Subtraction using 1's and 2's complement method 1.4 Codes: BCD, Gray code, Excess-3 and ASCII code,Code conversions, Applications of codes. 1.5 BCD Arithemetic: BCD Addition, Subtraction using 9's and 10's complement	Lecture Using 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.
2	TLO 2.1 Define the given characteristics parameters of the digital logic families. TLO 2.2 Draw symbol and truth table of given logic gates. TLO 2.3 Explain the concept of Buffer and Tristate logic . TLO 2.4 Implement basic gates and other gates with the help of universal gate. TLO 2.5 Simplify the given expression using Boolean laws and develop logic circuits .	**Unit - II Logic Gates and Boolean Algebra** 2.1 Logic Families: Characteristics Parameters of logic Families- Noise margin, Power dissipation, Figure of merit ,Fan in, Fan out, Speed of operation, maximum clock frequency supply voltage requirement ,power per gate , Comparison of TTL, CMOS and ECL logic family 2.2 Introduction to positive and negative logic systems, Logic Gates: Symbol ,Truth table of Basic logic gates(AND,OR,NOT),Universal gates(NAND,NOR) and Special purpose gates(EX-OR,EX-NOR) 2.3 Buffer: Tristate logic, Unidirectional and Bidirectional 2.4 Boolean algebra : Laws of Boolean algebra, Duality Theorem ,De-Morgan's theorem	Flipped Classroom Lecture Using Chalk-Board
3	TLO 3.1 Develop logic circuits for standard SOP/POS form of the given logic expression. TLO 3.2 Minimize the given logic expression using K-map (up to 4 variables). TLO 3.3 Design Adder and subtractor using K-map. TLO 3.4 Describe working of specified Encoder and Decoder with help of block diagram and truth table. TLO 3.5 Describe the working of Multiplexer and Demultiplexer.	**Unit - III Combinational Logic Circuits** 3.1 Standard Boolean expression: Sum of products [SOP] and Products of Sum [POS], Min-term and Max-term, SOP-POS form conversion, realisation using NAND/NOR gates 3.2 Boolean Expression reduction using K-map: Minimization of Boolean expressions (upto 4 variables) using SOP and POS form 3.3 Arithemetic circuits : design Half and Full Adder using K-maps, design Half and Full Subtractor using K-maps , n bit adder and n bit subtractor . 3.4 Encoder and Decoder: Functions of Encoder and Decoder, Block Diagram and Truth table, Priority Encoder (4:2, 8:3), BCD to 7 segment Decoder/Driver, Keyboard Encoder / decoder 3.5 Multiplexer and Demultiplexer: Working, Truth table and applications of MUX and DEMUX. MUX tree, DEMUX tree, DEMUX as Decoder	Flipped Classroom Presentations Lecture Using 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.
4	TLO 4.1 Differentiate between Latch and Flip Flop. TLO 4.2 Explain basic memory cell and use relevant triggering technique for the given digital circuit. TLO 4.3 Describe the truth tables for the given Flip flops, applications of Flip flops. TLO 4.4 Use the given type of flip flop and its excitation table to design specific type of counter. TLO 4.5 Describe the working of specified shift register with the help of timing diagram. TLO 4.6 Design specified modulo-N counter using Flip flops . TLO 4.7 Design Ring /Twisted ring counter using given Flip-Flop.	**Unit - IV Sequential Logic Circuits** 4.1 Difference between Combinational and Sequential Logic circuits, Time independent (un-clocked)and Time dependent (Clocked) logic system , Flips- Flops and Latch, Basic memory cell ,RS-Latch using NAND and NOR, Triggering methods- Edge trigger and Level Trigger 4.2 Flip-Flops: S-R, J-K, T and D, Truth table and logic circuits of each flip-flop, Excitation table, applications 4.3 Race around condition in JK flip-flop, Master- Slave JK Flip Flop 4.4 Shift registers- Serial In Serial Out, Serial In Parallel Out, Parallel In Serial Out ,Parallel In Parallel Out,Bi-directional Shift register, 4-bit Universal Shift register 4.5 Counters- Synchronous and Asynchronous counters, Modulus of counter, Ripple counter, Ring Counter, Twisted Ring Counter, Up – down counter, Decade Counter, MOD-N counter, Timing Diagram	Video Demonstrations Lecture Using Chalk-Board Simulation
5	TLO 5.1 Describe the working of the given type of DAC. TLO 5.2 Calculate the output voltage for the given digital input for specified DAC. TLO 5.3 Describe the working of the given type of ADC. TLO 5.4 Compare working of ROM,EPROM, EEPROM and Flash Memory .	**Unit - V Data Converters and Memories** 5.1 Digital to Analog Data Converter (DAC)- circuit diagram and working of Weighted resistor DAC and R-2R Ladder DAC, DAC Specification/Selection factors 5.2 Analog to Digital Data Converter (ADC) : Block Diagram, Types and Working of Dual Slope ADC, Successive Approximation, Flash Type ADC, ADC selection factors/ specifications 5.3 Memories: Types- Primary memory , Secondary Memory, Organization, Dimension, Memory Bank, Features , Applications: RAM (SRAM, DRAM), Volatile and Non-Volatile, ROM (PROM, EPROM, EEPROM), Flash Memory, Comparison of RAM and ROM,EPROM and Flash Memory, SIMM: Features, SSD memory: Features,	Video Demonstrations Lecture Using 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 Test the functionality of basic gates. LLO 1.2 Test the functionality of special purpose gates.	1	* Test the functionality of AND, OR, NOT, Ex-OR and EX-NOR logic Gates using equivalent 74 series or CMOS Devices [CD] series.	2	CO1 CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Test the functionality of NAND and NOR gate using breadboard.	2	* Test the functionality of the given Universal Gates using equivalent 74 series /CD series.	2	CO2
LLO 3.1 Test the functionality of the constructed Basic gates using universal gates.	3	* Construct Basic Gates using Universal Gates.	2	CO2
LLO 4.1 Construct Ex-OR, EX-NOR gates using universal gates.	4	Construct Exclusive Gates using Universal Gates.	2	CO2
LLO 5.1 Build the logic circuit on breadboard to verify the De - Morgan's theorems.	5	* Verify De-Morgan's Theorem (1 and 2).	2	CO2
LLO 6.1 Verify the truth table of Half and Full adder circuits for the given input.	6	* Implement 2 input, 3 input Adder Circuit.	2	CO3
LLO 7.1 Verify the truth table of Half and Full subtractor using Boolean expressions.	7	Implement 2 input, 3 input Subtractor Circuit.	2	CO3
LLO 8.1 Construct and test BCD to 7 segment decoder using Digital IC.	8	Test the output of BCD to 7 Segment Decoder using Digital IC for the given inputs.	2	CO3
LLO 9.1 Build/Test 2 or 4 bit Magnitude comparator using Digital IC.	9	Check the output of comparator circuit consisting of Digital IC.	2	CO3
LLO 10.1 Build / test function of MUX Digital IC.	10	* Build and test the functionality of 4:1/8:1 Multiplexer.	2	CO3
LLO 11.1 Build / test function of DEMUX Digital IC.	11	Build and test the functionality of 1:4/1:8 De-Multiplexer.	2	CO3
LLO 12.1 Test functionality of RS flip flop using NAND Gate .	12	Implement and verify the truth table of RS Flip flop.	2	CO4
LLO 13.1 Test functionality of Master Slave (MS) JK flip-flop using Digital IC.	13	Implement and test the functionality of master slave- JK Flip Flop using Digital IC.	2	CO4
LLO 14.1 Test functionality and truth table for D and T Flip flop.	14	Use Digital IC to construct and test the functionality of D and T flip flop.	2	CO4
LLO 15.1 Interpret timing diagram of 4 bit Universal Shift Register.	15	Build 4- bit Universal Shift register and observe the timing diagram.	2	CO4
LLO 16.1 Interpret timing diagram of 4-bit ripple counter using Digital IC.	16	Implement Ripple Counter using Digital IC.	2	CO4
LLO 17.1 Interpret timing diagram of Decade counter (Mod-10).	17	* Implement Decade Counter Using Digital IC.	2	CO4
LLO 18.1 Build R-2R resistive network on breadboard to convert given digital data into analog.	18	* Test the output of given R-2R type Digital to Analog Converter for the given input.	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

- Implement 1:8 DEMUX using 1:4 /1:2 DE-MUX.
- Build a circuit to implement 4 Bit adder.
- Build a 4bit parity generator and parity tester.
- Implement 16:1 MUX using 8:1/4:1 MUX.
- Build a circuit to test 7 bit segment display.
- Build a LED display bar.
- Develop a project on Burglar alarm.
- Light Detector circuit using NAND gate.

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Digital Storage Oscilloscope 25MHz/60MHz/70MHz/100MHz Dual Channel, 4 Trace CRT / TFT based X10 magnification 20 nS max sweep rate, Alternate triggering Component tester and with optional features such as Digital Read out, USB interface. Any other Oscilloscope with additional features is also suitable with magnifying probe at least two probes, if possible isolated probe	15,16,17
2	Trainer kit for 4 bit Counter using Flip Flops 4 bit ripple counter synchronous counter IC 7476 based circuit, Input given by switches and output indicated on LED, Facility to select MOD 8 or MOD 16 mode, Built in DC power supply and manual pulser with indicator	16,17
3	Trainer kit IC DAC IC 0800 Trainer based on IC 0800, 8 bit digital input selected by switches and provision for measurement of analog output. Facility to study effect of change in reference voltage, Built in buffer amplifier, Built in DC power supply	18
4	Digital multimeter 3.5 digit with R , V, I measurements, diode and BJT testing	All
5	Digital IC Tester Tests a wide range of Analog and Digital ICs such as 74 series /CD series	All
6	Bread Board Development System Bread Board system with DC power output 5V,+/-12V and 0-5V variable , digital voltmeter ,ammeter , LED indicators 8 no , logic input switches 8 no, 7 segment display 2 no, clockgenerator	All
7	Trainer kits for digital ICs Trainer kit should consists of digital ICs for logic gates, flop flop, shift registers, counter alongwith toggle switches for inputs and bi-colourLED at outputs, built in power supply	All

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

DIGITAL TECHNIQUES **Course Code : 313303**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Number Systems	CO1	5	2	4	2	8
2	II	Logic Gates and Boolean Algebra	CO2	8	2	4	6	12
3	III	Combinational Logic Circuits	CO3	12	4	6	8	18
4	IV	Sequential Logic Circuits	CO4	12	4	6	8	18
5	V	Data Converters and Memories	CO5	8	4	6	4	14
Grand Total				**45**	**16**	**26**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

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

Summative Assessment (Assessment of Learning)

- End semester assessment is 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	-	-	-	3			
CO2	2	-	2	-	-	-	2			
CO3	3	2	3	2	-	1	2			
CO4	3	2	3	2	-	1	2			
CO5	2	-	2	2	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	Jain R.P	Modern Digital Electronics	McGraw-Hill Publishing, New Delhi,2009 ISBN:9780070669116
2	Anand Kumar	Fundamentals of Digital Circuits	PHI learning Private limited, ISBN:978-81-203-5268-1
3	Salivahanan S, Arivazhagan S.	Digital Circuits and Design	Vikas Publishing House, New Delhi,2013 ISBN: 9789325960411
4	Puri.V.K	Digital Electronics	McGraw-Hill Publishing, New Delhi,2016 ISBN:97800746331751

Sr.No	Author	Title	Publisher with ISBN Number
5	Malvino A.P Donald .P. Leach	Digital Principles	McGraw-Hill Education, New Delhi ISBN:9789339203405
6	Anil.K.Maini	Digital Electronics: Principles, Devices and Applications	Wiley India, Delhi, 2007, ISBN:9780470032145
7	Floyd, Thomas	Digital Fundamentals	Pearson Education India, Delhi 2014,ISBN:9780132737968
8	G.K.Kharate	Digital Electronics	Publisher: Oxford University Press, ISBN: 9780198061830

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://studytronics.weebly.com/digital-electronics.html	Basics of Digital Electronics
2	https://www.udemy.com/course/basics-of-digital-techniques/	Introduction To Digital Number System & Logic Gates
3	https://www.geeksforgeeks.org/synchronous-sequential-circuits-in-digital-logic/	Boolean Algebra and Logic Gates, Combinational and Sequential Logic Circuits
4	https://onlinecourses.nptel.ac.in/noc19_ee51/preview	Digital Circuits
5	https://de-iitr.vlabs.ac.in/	Virtual Labs for Digital Systems
6	https://www.tutorialspoint.com/digital_circuits/digital_circuits_sequential_circuits.htm	Sequential Circuits

Note :

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

DATA STRUCTURE USING PYTHON **Course Code : 313306**

Programme Name/s : **Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Data Sciences**

Programme Code : **AI/ AN/ DS**

Semester : **Third**

Course Title : **DATA STRUCTURE USING PYTHON**

Course Code : **313306**

I. RATIONALE

Data structures are mathematical and logical model of storing and organizing data in a particular way in computer. Python is powerful programming language, it is effective for introducing computing and problem solving to beginners.Python has efficient high-level data structures and a simple but effective approach to object-oriented programming . After completing this course, student will be able to implement different types of data structures to solve real life problems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following Industry Identified Outcomes through various teaching learning experiences:

• Implement Data Structures using Python to solve problems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Develop Python program using basic syntactical constructs.
- CO2 - Perform operations on sequence structures in Python.
- CO3 - Implement Modules, Packages in Python for given problem.
- CO4 - Design classes for given problem.
- CO5 - Implement Linear Data Structure in Python.
- CO6 - Develop Python program to implement tree data structure.

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	
313306	DATA STRUCTURE USING PYTHON	DSP	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

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

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the given variables, keywords and constants in Python. TLO 1.2 Use indentation, comments in the given program. TLO 1.3 Use different types of operators for writing arithmetic expressions. TLO 1.4 Write Python programs using control flow.	**Unit - I Introduction and Control Flow statements in Python** 1.1 Features of Python - interactive, object oriented, interpreted, platform independent. 1.2 Python building blocks - identifiers, keywords, indentation, variables, comments. 1.3 Python data types: numbers, string, tuples, lists, dictionary. 1.4 Basic operators: arithmetic, comparison/ relational, assignment, logical, bitwise, membership, identity operators , Python operator precedence. 1.5 Control flow: conditional statements (if, if else, nested if),looping in python (while loop, for loop, nested loops) loop manipulation using continue, pass, break, else.	Presentations Chalk-Board 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.
2	TLO 2.1 Develop Python program to manipulate lists for the given problem. TLO 2.2 Develop Python program to manipulate tuples for the given problem. TLO 2.3 Write Python program to manipulate sets for the given problem. TLO 2.4 Write Python program to manipulate dictionaries for the given problem. TLO 2.5 Develop relevant user defined functions for the given problem.	**Unit - II Python specific Data Structures and functions** 2.1 Lists: Defining lists, accessing values in list, deleting values in list, updating lists, basic list operations, built - in list functions. 2.2 Tuples: Accessing values in tuples, deleting values in tuples, and updating tuples, basic tuple operations, built - in tuple functions. 2.3 Sets: Accessing values in set, deleting values in set and updating sets, basic set operations, built - in set functions. 2.4 Dictionaries: Accessing values in dictionary, deleting values in dictionary and updating dictionary, basic dictionary operations, built- in dictionaries functions. 2.5 Use of Python built- in functions (e.g.type/ data conversion functions, math functions etc.) 2.6 User defined functions: Function definition, function calling, function arguments and parameter passing, return statement, scope of variables: global variable and local variable.	Presentations Chalk-Board Hands-on
3	TLO 3.1 Create Python module for the given problem. TLO 3.2 Develop Python package for the given problem. TLO 3.3 Use NumPy for performing mathematical operations on arrays.	**Unit - III Python Modules and Packages** 3.1 Modules: writing modules, importing modules, importing objects from modules, Python built- in modules (e.g. numeric and mathematical module, functional programming module). 3.2 Python packages: introduction, writing Python packages. 3.3 Using standard Numpy: methods in Numpy, creating arrays and initializing, reading arrays from files,special initializing functions, slicing and indexing, reshaping arrays, combining arrays, NumPy maths.	Chalk-Board Presentations Hands-on
4	TLO 4.1 Apply the basic concepts of object oriented programming to define classes and objects. TLO 4.2 Implement the concept of polymorphism TLO 4.3 Create Python program using inheritance for the given problem	**Unit - IV Object Oriented Programming in Python** 4.1 Introduction to object oriented programming, creating classes and objects, constructor and destructor in Python. 4.2 Data abstraction and data encapsulation. 4.3 Concept of polymorphism- method overloading and overriding. 4.4 Inheritance and types of inheritance.	Chalk-Board 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.
5	TLO 5.1 Describe linear data structures in Python. TLO 5.2 Develop Python code using arrays for given problem. TLO 5.3 Write Python code to implement link list for given problem. TLO 5.4 Implement stack in Python program. TLO 5.5 Implement queues in Python program.	**Unit - V Linear Data Structure Arrays, Link List, Stack and Queues using Python.** 5.1 Data Structures – definition, linear data structures, non-linear data structures arrays - overview, types of arrays, operations on arrays, arrays vs list. 5.2 Searching -linear search and binary search, sorting - bubble sort, insertion sort. 5.3 Linked Lists – singly linked list, doubly linked list, circular linked lists, implementation using Python packages for link list. 5.4 Stacks : introduction to stacks, stack applications - expression evaluation, backtracking, traversal - infix, prefix and postfix concepts. 5.5 Queues: introduction to queues, queue applications - breadth first search, depth first search.	Presentations Chalk-Board Flipped Classroom
6	TLO 6.1 Implement various types of trees using Python code. TLO 6.2 Perform various operations on trees using Python code.	**Unit - VI Non-Linear Data Structure.** 6.1 Trees - tree Terminology, binary trees: implementation, tree traversals, binary search trees 6.2 Applications of trees - spanning tree, BST , tree traversal - inorder, preorder and postorder concepts.	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 Install Python integrated development environment.	1	* a) Install and configure Python IDE . b) Write Python program to display message on screen	2	CO1
LLO 2.1 Implement basic operators in Python.	2	* Write simple Python program using operators: a) Arithmetic operators b) Logical operators c) Relational operators d) Conditional operators e) Bitwise operators f) Ternary operator	2	CO1
LLO 3.1 Implement control flow operations for solving given task.	3	* Write simple Python program to demonstrate use of conditional statements : i) if ii) if…else iii) Nested if iv) Switch case	4	CO1
LLO 4.1 Implement while control loop for solving iterative problems.	4	Develop a simple Python program to demonstrate use of control loop: while	2	CO1
LLO 5.1 Implement for loop for solving iterative problems.	5	* Create a simple program to demonstrate use of for loop in Python (e.g : various pattern building, printing multiplication table, checking palindrome number etc.)	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Perform basic operations on the lists.	6	* Write Python program to perform following operations on lists : a) Create b) Access c) Update d) Delete elements in list	2	CO2
LLO 7.1 Execute various tuple operations.	7	Develop Python program to perform following operations on tuples: a) Create b) Access c) Update d) Delete tuple elements	2	CO2
LLO 8.1 Implement various set operations.	8	* Write Python program to perform following operations on set : a) Create b) Access c) Update d) Delete access set elements	2	CO2
LLO 9.1 Execute various operations on dictionaries.	9	* Create a program to perform following operations on dictionaries in Python: a) Create b) Access c) Update d) Delete e) Looping through dictionary	2	CO2
LLO 10.1 Use built-in math functions in Python.	10	Apply math built - in function in Python.	2	CO2
LLO 11.1 Create user-defined functions to solve the given task	11	* Develop user defined Python function for given problem: write a function with minimum 2 arguments	2	CO2
LLO 12.1 Apply built-in mathematical modules from python.	12	Create a program to demonstrate use of built-in module (e.g. numeric, mathematical functional and programming module) in Python.	2	CO3
LLO 13.1 Write user-defined module in Python.	13	* Write program to ceate a user - defined module (e.g : building calculator) in Python.	2	CO3
LLO 14.1 Apply built-in packages from Python.	14	* Develop Python program to demonstrate use of NumPy packages for creating , accessing and performing different array operations.	2	CO4
LLO 15.1 Create user-defined packages in Python.	15	Write a program to create user defined packages in Python.	2	CO4
LLO 16.1 Implement the concept of polymorphism in Python.	16	Write program in Python to demonstrate following operations: a) Method overloading b) Method overriding	2	CO4
LLO 17.1 Implement the concept of inheritance in Python.	17	* Develop program in Python to demonstrate following operations: a) Single inheritance b) Multilevel inheritance c) Multiple inheritance d) Hybrid inheritance e) Hierarchical inheritance	4	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 18.1 Execute the array operations using Python.	18	* Write a program in Python for handling array to demonstrate following operations : a) Array declaration b) Insertion c) Deletion d) Append e) Index f) Reverse	4	CO5
LLO 19.1 Implement the linked list operations using Python.	19	* Write a program in Python for linked list to demonstrate following operations : a) Insertion b) Deletion c) Updating d) Merging to list	4	CO5
LLO 20.1 Implement the queue operations using Python.	20	* Write a program in Python to demonstrate queue data structure operations : a) Enqueue b) Dequeue c) Display	4	CO5
LLO 21.1 Implement searching techniques in Python.	21	* Use the searching techniques in data structures: a) Linear Search b) Binary Search	2	CO5
LLO 22.1 Implement sorting techniques in Python.	22	* Write a Python program to implement following sorting techniques: a) Bubble Sort b) Insertion Sort	4	CO5
LLO 23.1 Implement stack data structure in Python.	23	* Write a program in Python to evaluate an expression.	2	CO6
LLO 24.1 Implement sorting techniques in Python.	24	Write a program to create binary tree from the given list using binary tree module in Python.	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 micro project has to be industry based, internet based ,workshop based, laboratory based or field based as suggested by teacher.

a) Develop an application to create tic-tac-toe game.
b) Create a code generator. This can that take text as input, replaces each letter with another letter, and outputs the “encoded” message.
c) Build an interactive quiz. Build a personality or recommendation quiz that asks users some questions, stores their answers, and then performs some kind of calculation to give the user a personalized result based on their answers.
d) Build an alarm clock using snooze function.

Other

- Implement various applications of stacks.
- Compute the arithmetic mean along the specified axis using NumPy.

- Present a seminar on different IDE used in Python.

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	Hardware : Personal Computer , RAM minimum 2 GB onwards. Operating System : Windows 10 onwards Software : Any relevant Python IDE like IDLE/PyCharm/Spyder/PyDev etc.	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 and Control Flow statements in Python	CO1	6	2	4	6	12
2	II	Python specific Data Structures and functions	CO2	7	2	4	6	12
3	III	Python Modules and Packages	CO3	6	2	4	6	12
4	IV	Object Oriented Programming in Python	CO4	6	2	4	4	10
5	V	Linear Data Structure Arrays, Link List, Stack and Queues using Python.	CO5	12	2	4	8	14
6	VI	Non-Linear Data Structure.	CO6	8	2	4	4	10
Grand Total				**45**	**12**	**24**	**34**	**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 is to Process.
40% weightage is to Product.

Summative Assessment (Assessment of Learning)

- Laboratory Performance, Viva Voce

XI. SUGGESTED COS - POS MATRIX FORM

DATA STRUCTURE USING PYTHON **Course Code : 313306**

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	-	-	-			
CO2	2	2	2	1	-	-	1			
CO3	-	2	2	1	-	-	1			
CO4	2	2	2	1	1	2	1			
CO5	2	2	2	1	1	2	1			
CO6	2	2	2	1	-	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	Rao, K. Nageswara Shaikh Akbar	Python Programing	Scitech Publications (India) Pvt. Ltd. ISBN: 9789385983450
2	Michael T. Goodrich, Roberto Tamassia	Data Structures and Algorithms in Python	Wiley publication New Delhi 2016 ISBN: 978-81- 265-5423-2
3	Beazley, David	Python Essential Reference	4th Edition, Addison-Wesley Professional, ISBN: 9780672329784
4	Dr.Basant Agarwal	Hands-On Data Structures and algorithms with Python	3rd Edition, Packt publisher, ISBN : 9781801073448

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://onlinecourses.nptel.ac.in/noc22_cs26/preview	Online Learning Initiatives by IIT faculties.
2	https://www.geeksforgeeks.org/graph-data-structure-and-algorithms/	Data structures in Python
3	https://www.freecodecamp.org/news/object-oriented-programming-in-python/	Object Oriented Programming Concepts
4	https://realpython.com/python3-object-oriented-programming/	Basics Object Oriented Programming Concepts.

Note :

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

STATISTICAL MODELLING FOR MACHINE LEARNING **Course Code : 313307**

Programme Name/s : **Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Data Sciences**

Programme Code : **AI/ AN/ DS**

Semester : **Third**

Course Title : **STATISTICAL MODELLING FOR MACHINE LEARNING**

Course Code : **313307**

I. RATIONALE

Machine Learning refers to the automated identification of patterns in data. This course is included in curriculum to establish foundation for Artificial Intelligence and Machine Learning. Statistic, Probability, Interpolation and sampling methods are the core components of AI/ML. This course will enable students to implement mathematical concepts using R-Programming which will enhance the knowledge and skills to use the methodology for solving AI/ML based problems of various domains.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply Mathematics to solve real-world problems using AI/ML concept and principles to enhance decision-making, design and innovation with precision and efficiency.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Solve the given problem based on Statistic Techniques using R-Programming.
- CO2 - Implement Statistic methods using R-Programming.
- CO3 - Use Principles of Probability to solve given Problem.
- CO4 - Implement appropriate method based on the Interpolation.
- CO5 - Apply Sampling Methods to solve given problem using R-Programming.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313307	STATISTICAL MODELLING FOR MACHINE LEARNING	SML	DSC	3	1	4	2	10	5	3	30	70	100	40	25	10	50@	20	25	10	200

Total IKS Hrs for Sem. : Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
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 Solve problems based on Frequency Distribution. TLO 1.2 Calculate Mean, Median and Mode for all types of data. TLO 1.3 Find Mode and Median using Graphical method. TLO 1.4 Find Karl Pearson's and Bowley's Co-efficient of Skewness for the given data. TLO 1.5 Calculate the Measures of Kurtosis based on moment for given data.	**Unit - I Statistical Techniques** 1.1 Frequency Distribution: Definition, Basic terms. 1.2 Classification of Data: Raw, Ungroup and Group data. 1.3 Measures of Central Tendency: Mean, Median and Mode for all types of data. 1.4 Concept of Quartiles, Deciles and Percentiles for all types of data. 1.5 Geometric mean and Harmonic mean and Combined mean for given data. 1.6 Graphical Representation to find Mode (Histogram) and Median (Ogive curve). 1.7 Measures of Dispersion: Range, Mean Deviation, Standard Deviation, Variance. 1.8 Skewness: Types of skewness, Test of skewness, Co-efficient of skewness-Karl Pearson's and Bowley's coefficient. 1.9 Types of skewness in terms of Mean and Mode. 1.10 Measures of Kurtosis using central moment.	Classroom Lecture Flipped Classroom Demonstration
2	TLO 2.1 Fit straight line and second-degree polynomial using Least Square method. TLO 2.2 Calculate Coefficient of correlation using Karl-Pearson's and Spearman's Rank methods. TLO 2.3 Obtain the equation to the Line of Regression for the given data.	**Unit - II Statistical Methods** 2.1 Fitting of Straight Line y = a+bx using method of least square. 2.2 Fitting of second degree polynomial $y=a+bx+cx^2$ using method of least square. 2.3 Covariance of the data. 2.4 Correlations, Types of Correlations. 2.5 Scatter Or Dot-Diagram. 2.6 Karl-Pearson's and Spearman's Rank Coefficient of Correlation. 2.7 Regression Equation of line in two variables.	Classroom Lecture Flipped Classroom Demonstration

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 Solve problems using addition and multiplication probability theorem. TLO 3.2 Solve problems using Conditional Probability. TLO 3.3 Solve problems using Bayes' theorem.	**Unit - III Probability of Random Variable** 3.1 Probability : Definition, Terminologies. 3.2 Theorem of Probability: Addition, Multiplication. 3.3 Conditional probability. 3.4 Bayes' theorem.	Classroom Lecture Flipped Classroom Demonstration
4	TLO 4.1 Solve problems using Lagrange's interpolation formula. TLO 4.2 Construct forward and backward difference table. TLO 4.3 Solve problems using Forward, Backward, Shift, Inverse shift operators. TLO 4.4 Solve problems on Forward and Backward Interpolation. TLO 4.5 Solve problems on Extrapolation.	**Unit - IV Interpolation** 4.1 Introduction. 4.2 Lagrange's Interpolation formula. 4.3 Finite Differences: Forward difference, Backward difference, Shift operator, Inverse shift operator. 4.4 Relation between forward, backward, shift and inverse shift operator. 4.5 Newton's Gregory forward and backward difference Interpolation Formula. 4.6 Concept of Extrapolation.	Classroom Lecture Flipped Classroom Presentations
5	TLO 5.1 Solve the given problem using Sampling distribution proportion. TLO 5.2 Test samples using t-Distribution. TLO 5.3 Test samples using chi-Square Distribution. TLO 5.4 Use Chi-Square test to test the Independence.	**Unit - V Sampling Methods** 5.1 Population, Sampling, Aim of Sampling, Parameters and Statistic, Types of Sampling, Standard Error. 5.2 Hypothesis: Null Hypothesis and Alternating Hypothesis. 5.3 Level of Significance, Test of Significance and Confidence Limits. 5.4 Test of Significance of Large Samples (N>30). 5.5 Sample Distribution of the proportion. 5.6 Comparison of Large Samples. 5.7 The t-Distribution (For Small Samples). 5.8 Chi-Square Distribution, Condition for Chi Square test. 5.9 Degree of freedom. 5.10 Chi-Square Test of Goodness of fit and Chi-Square test as a test of Independence.	Classroom Lecture Presentations Demonstration

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Download and Install R studio and R Packages.	1	* Download R Studio.Install and configure R studio and R Packages.	2	CO1
LLO 2.1 Implement basic mathematical operations in R programming.	2	Write Program to- a. Demonstrate the use of R-Numbers. (numeric, integer, complex). b. Convert number from one type to other using functions. c. Perform following operations. i. Addition and Subtraction on numbers. ii. Find Square root using of number using built-in function.	2	CO1

STATISTICAL MODELLING FOR MACHINE LEARNING **Course Code : 313307**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Perform given operation on Datasets using R programming.	3	Write Program to- a. Print any built-in data set of R. b. Get information about the data set. c. Find the dimensions of the data set and view the names of the variables. Hint: Use dim( ) and names( ) function. d. Find the name of each row in the first column. Hint: Use the rownames( ) function. e. Print all values that belong to a variable. f. Sort the values of variable. g. Get the statistical summary of the data.	2	CO1
LLO 4.1 Find lowest and highest values and index position of max and min value from dataset using R Program.	4	Write a program to- a. Find the lowest or highest value in a data set. Hint: Use min( ) and max( ) functions. b. Find the index position of the max and min value in the table. Hint: use which.max( ) and which.min( ) functions.	2	CO1
LLO 5.1 Calculate Measures of Central tendency including Quartiles using R Program.. LLO 5.2 Calculate Deciles and Percentiles using R Program.	5	* Write programs to calculate Measures of Central tendency. a. Import data into R. b. Calculate the Mean (Average value) of a variable from the given data set. c. Find the Median (Mid-Point value) of the variable from the given data set. d. Calculate the mode for the variable from the given data set.(by sorting the column of the dataframe and by using the 'modest' package). e. Calculate the Percentile of the variable from the given data set.	4	CO1
LLO 6.1 Create Frequency Distribution table using R Programming.	6	* Write programs to- a. Print Original Data Frame, Modified Frequency Table, Cumulative Frequency Table, Relative Frequency Table. b. Create the Frequency Table by using multiple arguments. c. Plot the frequency table using ggplot function.	2	CO1
LLO 7.1 Calculate measures of Dispersion using R Program.	7	* Write programs to calculate-Variance, Standard Deviation, Range, Mean Deviation for the given data.	2	CO1
LLO 8.1 Draw Histogram and Ogive Curve to graphically represent Mode and Median for the given data.	8	* Write Programs to graphically represent mode and median of the given data. a. Draw Histogram for the given data. b. Draw Ogive Curve for the given data.	2	CO1
LLO 9.1 Calculate Skewness for the given data using R Program.	9	* Write a Program to calculate Skewness for the given data.	2	CO1
LLO 10.1 Draw a scatterplot for the given data using R Program.	10	Write a Program to draw a scatterplot for two variables for the given dataset.	2	CO1

STATISTICAL MODELLING FOR MACHINE LEARNING **Course Code : 313307**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Perform the correlation test to evaluate the association between two or more variables using R Program.	11	Write Program to perform the correlation test to evaluate the association between two or more variables. a. Install and load required R packages. b. Compute correlation in R. c. Visualize your data using scatter plots. d. Perform Preliminary test to check the test assumptions.	2	CO2
LLO 12.1 Perform the correlation test to evaluate the association between two or more variables using R Program.	12	* Write Program to perform the correlation test to evaluate the association between two or more variables. a. Pearson correlation test. b. Interpretation of the result. c. Use Spearman rank correlation coefficient to estimate a rank-based measure of association.	4	CO2
LLO 13.1 Find the Line of Regression for two variables using R Program.	13	* Write a Program based on Line of Regression using two variables.	2	CO2
LLO 14.1 Implement Classical Probability using R Program.	14	* Write Programs to- a. Calculate the probability of getting heads when flipping a fair coin. b. Calculate the probability of drawing a spade from a standard deck of 52 cards.	4	CO3
LLO 15.1 Implement Classical Probability using R Program.	15	Write a program to calculate the probability of rolling a 3 on a fair six-sided die.	2	CO3
LLO 16.1 Compute probability using R Program.	16	Write a program to compute probability using prob( ) function.	2	CO3
LLO 17.1 Calculate the conditional probability using R Program.	17	Write a program to calculate the conditional probability.	2	CO3
LLO 18.1 Calculate the probability of an event based on given information using R Program.	18	* Write a program to use Bayes' Theorem in R-Programming.	4	CO3
LLO 19.1 Find forward Interpolation using R Program.	19	* Write a Program to interpolate using newton forward interpolation.	2	CO4
LLO 20.1 Find backward Interpolation using R Program.	20	* Write a Program to interpolate using newton backward interpolation.	2	CO4
LLO 21.1 Find Extrapolation using R Program.	21	* Write a program for the implementation of extrapolation.	2	CO4
LLO 22.1 Generate Samples for the given dataset using R Program.	22	Write a program to generate Samples using the Sampling Functions.	2	CO5
LLO 23.1 Perform the given type of sampling using R program.	23	Write programs to perform following types of sampling- a. Simple Random Sampling. b. Stratified Sampling. c. Systematic Sampling. d. Biased Sampling.	2	CO5
LLO 24.1 Generate Sampling Distribution proportion using R program.	24	* Write a program to generate a Sampling Distribution proportion.	2	CO5
LLO 25.1 Perform Hypothesis Testing by t-Distribution using R program.	25	* Write a program based on t-Distribution using dt, pt, qt & rt functions.	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 26.1 Perform Hypothesis Testing by Chi-Square Distribution using R program.	26	* Write a program based on Chi-Square Distribution using dchisq, pchisq, qchisq & rchisq functions.	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)

Assignment

- Collect data of at least 05 real world examples and test the Hypothesis of sampling distribution.
- Collect data of at least 05 real world examples and calculate Measures of skewness and kurtosis and prepare the document.
- Collect data of at least 05 real world examples and draw/fit straight line and second-degree polynomial.
- Collect data of at least 05 real world examples and calculate probability using Bayes' theorem.
- Collect data of at least 03 city like cost of living and temperature data etc. and interpolate the missing index number for it and prepare the document.

Micro project

- Analyze Uber Data: Analyze different parameters like the number of trips made in a day, the number of trips during a particular month, average passenger that uber can have in a day, the peak hours where more customers are available, maximum number of trips found on day of the month, etc.
- Implement each least squares regression technique using a programming language such as Python or R. Utilize libraries like scikit-learn or stats models for implementation, ensuring proper parameter tuning and regularization settings for each technique.
- Collect temperature data from different locations at various times of the day. Use interpolation techniques such as linear interpolation or spline interpolation to estimate the temperature at specific times and locations where data is not available.
- Design a simple hypothesis testing scenario where you simulate data under different conditions and perform chi-square tests to assess the significance of observed difference.
- Perform case Study on probabilistic model for predicting relations in social websites system.

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

STATISTICAL MODELLING FOR MACHINE LEARNING **Course Code : 313307**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Open-source software like SageMaths, MATHS3D, GeoGebra, Graph, DPLOT, and Graphing Calculator (Graph Eq 2.13), ORANGE can be used for Graph theory and tree, Statistics respectively.	All
2	Minimum Hardware requirement: Personal computer, (i3-i5 preferable), RAM minimum 4 GB onwards.	All
3	Minimum system requirement: 64-bit operating system such as Windows 10, macOS 10.13, or a recent version of Linux.	All
4	Software: R-Studio	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	Statistical Techniques	CO1	10	2	6	12	20
2	II	Statistical Methods	CO2	10	2	4	8	14
3	III	Probability of Random Variable	CO3	7	2	2	4	8
4	IV	Interpolation	CO4	10	2	4	8	14
5	V	Sampling Methods	CO5	8	2	4	8	14
Grand Total				**45**	**10**	**20**	**40**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Laboratory Performance, Unit Tests , Midterm Exam, Self-learning, Term Work, Seminar/Presentations.
- 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 Exam, Practical exam, 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	3	1	1	-	-	-	1			
CO2	3	2	1	1	1	-	1			
CO3	3	2	2	1	-	1	2			
CO4	3	2	2	1	-	1	1			
CO5	3	2	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	H.K.Dass, Er.Rajnish Verma	Higher Engineering Mathematics	S. Chand Technical ISBN: 9788121938907,9788121938907
2	A.C. Srivastava, P.K. Srivastava	Engineering Mathematics	PHI Publication, New Delhi ISBN: 9788120342934
3	Grewal B. S.	Higher Engineering Mathematics	Khanna Publication New Delhi, 2013 ISBN: 8174091955
4	B. V. Ramana	Higher Engineering Mathematics	Tata Mcgraw Hill Education private limited, New Delhi. ISBN: 9780070634190, 9780070634190
5	Marvin L. Bittinger David J. Ellenbogen Scott A. Surgent	Calculus and Its Applications	Addison-Wesley 10th Edition ISBN-13: 978-0-321-69433-1
6	Andrie de Vries and Joris Meys	R For Dummies	Wiley Publisher ISBN-13: 978-8126562183
7	Jeeva Jose	Beginner's Guide for Data Analysis using R Programming	Khanna Book Publishing, First Edition ISBN-13: 978-9386173454

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://nptel.ac.in/courses/106102064/1	Online Learning Initiatives by IITs and IISc
2	https://ocw.mit.edu/	MIT Open courseware
3	https://www.khanacademy.org/math	Concept of Mathematics through video lectures and notes
4	www.mathworks.com/	Applications of concepts of Mathematics to coding.
5	https://amser.org/b920509/science--mathematics	AMSER (Interpolation. Extrapolation
6	https://www.coursera.org/learn/r-programming	R Programming: Free online Course
7	https://libguides.furman.edu/oer/subject/mathematics	Open Education Resources (OER) in Mathematics. (Interpolation. Extrapolation
8	https://www.wolframalpha.com/	Solving Mathematical Problems, performing calculations, visualizing mathematical concepts.
9	https://brilliant.org/	Interactive Learning in Mathematics
10	https://www.w3resource.com/r-programming-exercises/basic/	R Programming Basic, Exercises, Practice, Solution
11	www.datamentor.io/r-programming/examples/	R Programming Examples
12	https://www.tutorialspoint.com/r_programming_language/index.asp	R-Programming Online Course
13	https://www.freecodecamp.org/news/all-the-math-you-need-in-artificial-intelligence/	Mathematics in AI
14	https://byjus.com/maths/least-square-method/	Least Square Method
15	https://www.w3resource.com/r-programming-exercises/basic/r-programming-basic-exercise-3.php	R-Programming: Basic Exercises with Solution

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Sr.No	Link / Portal	Description

Note :

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