Maharashtra State Board Of Technical Education, Mumbai

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

Programme Name	**: Diploma In Computer Technology / Computer Engineering / Computer Science & Engineering / Computer Science**		
Programme Code	**: CM / CO / CW / SE**	**With Effect From Academic Year**	**: 2023-24**
Duration Of Programme	**: 6 Semester**	**Duration**	**: 12 Weeks (Industry) + 10 Weeks (Institute)**
Semester	**: Fifth** **NCrF Entry Level : 4.0**	**Scheme**	**: K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme												
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning		Total Marks
																	Practical						
						CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
													Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
(All Compulsory)																								
1	OPERATING SYSTEM	OSY	DSC	315319	-	5	-	2	2	9	3	3	30	70	100	40	25	10	25@	10	25	10	175
2	SOFTWARE ENGINEERING	STE	DSC	315323	-	4	-	4	1	9	3	3	30	70	100	40	25	10	25@	10	25	10	175
3	ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS	ENDS	AEC	315002	-	1	-	2	-	3	1	-	-	-	-	-	50	20	25@	10	-	-	75
4	SEMINAR AND PROJECT INITIATION COURSE	SPI	AEC	315003	-	-	-	1	2	3	1	-	-	-	-	-	25	10	25@	10	25	10	75
5	INTERNSHIP(12 WEEKS)	ITR	INP	315004	-	-	-	-	-	36 - 40	10	-	-	-	-	-	100	40	100#	40	-	-	200
Elective 1 (Any - One)																								
6	ADVANCE COMPUTER NETWORK	ACN	DSE	315321	-	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150
	CLOUD COMPUTING	CLC	DSE	315325	-	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150
	DATA ANALYTICS	DAN	DSE	315326	-	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150
Total						**14**		**11**	**5**		**20**		**90**	**210**	**300**		**250**		**225**		**75**		**850**

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

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

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

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 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.

Note: Notional learning hours for **internship represents the student engagement hours.**

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

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS **Course Code : 315002**

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Civil & Environmental Engineering/ Computer Science/ Electronics & Computer Engg.**
Programme Code	**: AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ SE/ TE**
Semester	**: Fifth**
Course Title	**: ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS**
Course Code	**: 315002**

I. RATIONALE

Entrepreneurship and Startups are introduced in this curriculum to develop the entrepreneurial traits among the students before they enter into professional life. Exposing and interacting with entrepreneurship and startup eco-system, students will develop entrepreneurial mind set. The innovative thinking with risk-taking ability along with other traits will be inculcated in the students through micro-projects and training. This exposure will be instrumental in orienting the students in transforming them to become job generators after completion of Diploma in Engineering.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Develop project proposals for launching small scale enterprises and starts up.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify one's entrepreneurial traits.
- CO2 - Use information collected from stakeholder for establishing/setting up/founding starts up
- CO3 - Use support systems available for Starts up
- CO4 - Prepare project plans to manage the enterprise effectively

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	
315002	ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS	ENDS	AEC	1	-	2	-	3	1	-	-	-	-	-	50	20	25@	10	-	-	75

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.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Compare advantages and disadvantages of Entrepreneurship TLO 1.2 Identify entrepreneurial traits through self-analysis TLO 1.3 Compare risk associated with different type of enterprise	**Unit - I Introduction to Entrepreneurship Development** 1.1 Entrepreneurship as a career – charms, advantages, disadvantages , scope- local and global 1.2 Traits of successful entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking, handling business communication, commitment to work contract, calculated risk taking, learning from failure 1.3 Types of enterprises and their features : manufacturing, service and trading	Presentations Lecture Using Chalk-Board
2	TLO 2.1 Explain Important factors essential for selection of product/service and selection of process TLO 2.2 Suggest suitable place for setting up the specified enterprise on the basis of given data/circumstances with justification. TLO 2.3 Suggest steps for the selection process of an enterprise for the specified product or service with justification. TLO 2.4 Plan a market study /survey for the specified enterprise	**Unit - II Startup Selection Process** 2.1 Product/Service selection: Process, core competence, product/service life cycle, new product/ service development process, mortality curve, creativity and innovation in product/ service modification / development 2.2 Process selection: Technology life cycle, forms and cost of transformation, factors affecting process selection, location for an industry, material handling. 2.3 Market study procedures: questionnaire design, sampling, market survey, data analysis 2.4 Getting information from concerned stakeholders such as Maharashtra Centre for Entrepreneurship Development[MCED], National Institute for Micro, Small and Medium Enterprises [NI-MSME], Prime Minister Employment Generation Program [PMEGP], Directorate of Industries[DI], Khadi Village Instries Commission[KVIC]	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.
3	TLO 3.1 Explain categorization of MSME on the basis of turnover and investment TLO 3.2 Describe support system provided by central and state government agencies TLO 3.3 State various schemes of government agencies for promotion of entrepreneurship TLO 3.4 Describe help provided by the non governmental agencies for the specified product/service TLO 3.5 Compute breakeven point, ROI and ROS for the specified business enterprise, stating the assumptions made	**Unit - III Support System for Startup** 3.1 Categorization of MSME, ancillary industries 3.2 Support systems- government agencies: MCED, NI MSME, PMEGP,DI, KVIC 3.3 Support agencies for entrepreneurship guidance, training, registration, technical consultation, technology transfer and quality control, marketing and finance. 3.4 Breakeven point, return on investment (ROI) and return on sales (ROS).	Presentations Lecture Using Chalk-Board
4	TLO 4.1 Explain key elements for the given business plan with respect to their purpose/size TLO 4.2 Justify USP of the given product/ service from marketing point of view. TLO 4.3 Formulate business policy for the given product/service. TLO 4.4 Choose relevant negotiation techniques for the given product/ service with justification TLO 4.5 Identify risks that you may encounter for the given type of business/enterprise with justification. TLO 4.6 Describe role of the incubation centre and accelerators for the given product/service.	**Unit - IV Managing Enterprise** 4.1 Techno commercial Feasibility study, feasibility report preparation and evaluation criteria 4.2 Ownership, Capital, Budgeting, Matching entrepreneur with the project 4.3 Unique Selling Proposition [U.S.P.]: Identification, developing a marketing plan. 4.4 Preparing strategies of handling business: policy making, negotiation and bargaining techniques 4.5 Risk Management: Planning for calculated risk taking, initiation with low cost projects, integrated futuristic planning, definition of startup cycle, ecosystem , angel investors, venture capitalist 4.6 Incubation centers and accelerators : Role and procedure	Presentations 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 Collect information of successful entrepreneurial traits	1	*Preparation of report on entrepreneurship as	2	CO1
LLO 2.1 Identify different traits as an entrepreneur from various field LLO 2.2 Suggest different traits from identified problem	2	Case study on ‘Traits of Entrepreneur’	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Explore probable risks for identified enterprise.	3	*Case study on 'Risks associated with enterprise	2	CO1
LLO 4.1 Identify new product for development LLO 4.2 Prepare a newly developed product	4	*Preparation of report on 'Development of new Product	2	CO1 CO2
LLO 5.1 Identify Process for development of product for new startup	5	Preparation of Report on ' Process selection 'for new startup	2	CO1 CO2 CO3
LLO 6.1 Develop questioner for market survey	6	*Market survey for setting up new Start up	2	CO2 CO3
LLO 7.1 Interpret the use of Technology Life Cycle	7	A Case study on ' Technology life cycle' of any successful entrepreneur.	2	CO3
LLO 8.1 Use information related to support of startups from Government and non-government agencies' LLO 8.2 Prepare report for setting up startup	8	*Preparation of report on 'Information for setting up new startup' from MCED/MSME/KVIC etc	2	CO3 CO4
LLO 9.1 Compute ROI of successful enterprise.	9	Case study on 'Return on Investment (ROI)'of any successful startup	2	CO3
LLO 10.1 Calculate of ROS of any successful enterprise	10	Case study on 'Return on sales (ROS)'of any successful startup	2	CO3
LLO 11.1 Calculate Brake even point of any enterprise	11	Preparation of report on 'Brake even point calculation' of any enterprise.	2	CO3 CO4
LLO 12.1 Prepare feasibility report of given business	12	*Preparation of report on 'feasibility of any Techno-commercial business"	2	CO4
LLO 13.1 Plan a USP of any enterprise.	13	*A case study based on 'Unique selling Proposition (USP) of any successful enterprise	2	CO4
LLO 14.1 Prepare a project report using facilities of Atal Incubation center.	14	*Prepare project report for starting new startup using 'Atal incubation center (AIC)	2	CO1 CO2 CO3 CO4

Note : Out of above suggestive LLOs -

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

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

Micro project

- Prepare a 'Pitch- desk' for your start up
- Prepare a business plan for a. Market research b. Advertisement agency c. Placement Agency d. Repair and Maintenance agency e. Tour and Travel agency
- Prepare a 'Social entrepreneurship business plan, plan for CSR funding.
- Prepare a ' Women entrepreneurship business plan ' Choose relevant government scheme for the product/service

- Prepare a business plan for identified projects by using entrepreneurial eco system for the same (Schemes, incentives, incubators etc.)

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	Computers with internet and printer facility	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 Entrepreneurship Development	CO1	4	0	0	0	0
2	II	Startup Selection Process	CO2	2	0	0	0	0
3	III	Support System for Startup	CO3	2	0	0	0	0
4	IV	Managing Enterprise	CO4	2	0	0	0	0
Grand Total				**10**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Assessment during practicals

Summative Assessment (Assessment of Learning)

- End of term examination

XI. SUGGESTED COS - POS MATRIX FORM

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS **Course Code : 315002**

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	2	2	-	-	3	2			
CO2	2	2	2	2	-	3	2			
CO3	2	2	2	2	-	3	2			
CO4	2	2	2	2	-	3	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	Dr. Nishith Dubey, Aditya Vyas , Annu Soman , Anupam Singh	Un- boxing Entrepreneurship your self help guide to setup a successful business	Indira Publishing House ISBN 2023,978-93-93577-70-2
2	Gujral, Raman	Reading Material of Entrepreneurship Awareness Camp	Entrepreneurship Development Institute of India (EDI), GOI, 2016 Ahmedabad
3	Chitale, A K	Product Design and Manufacturing	PHI Learning, New Delhi, 2014; ISBN: 9788120348738
4	Charantimath, Poornima	Entrepreneurship Development Small Business Entrepreneurship	Pearson Education India, New Delhi; ISBN: 9788131762264
5	Khanka, S.S.	Entrepreneurship and Small Business Management	S.Chand and Sons, New Delhi, ISBN: 978-93-5161-094-6

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.mced.nic.in/allproduct.aspx	MCED Product and Plan Details
2	http://niesbud.nic.in/Publication.html	The National Institute for Entrepreneurship and Small Business Development Publications
3	http://niesbud.nic.in/docs/1standardized.pdf	Courses : The National Institute for Entrepreneurship and Small Business Development
4	https://www.nabard.org/Tenders.aspx?cid=501andid=24	NABARD - Information Centre
5	http://www.startupindia.gov.in/pdffile.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdfandc ontent_type=Actionandsubmenupoint=action	Start Up India
6	http://www.ediindia.org/institute.html	About - Entrepreneurship Development Institute of India (EDII)
7	http://www.nstedb.com/training/training.htm	NSTEDB - Training

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS **Course Code : 315002**

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

Programme Name/s	**: Automobile Engineering./ Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg. Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Scie & Information Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Production Engineering Computer Science/ Electronics & Computer Engg.**
Programme Code	**: AE/ AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ ME/ MK/ PG/ SE/ TE**
Semester	**: Fifth**
Course Title	**: SEMINAR AND PROJECT INITIATION COURSE**
Course Code	**: 315003**

I. RATIONALE

Most of the diploma graduates lack the confidence and fluency while presenting papers or interacting verbally and expressing themselv with a large gathering. Seminar presentation boosts the confidence of the students and prepares them precisely for facing the audienc interviews and group discussions. The course on seminar is to enhance student's ability in the art of academic writing and to present it. also helps broaden the minds of the participants. Through this course on Seminar, students will develop new ideas and perspectives of t subject /themes of emerging technologies and services of their area of studies. Project initiation enhances project planning skill whi establishes measurable objectives and interaction skills.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Present a seminar on the selected theme/area of study effectively and confidently to the specific audience and stakeholders. Plan innovative solutions independently or collaboratively to the identified problem statement.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify topics of seminar presenting to the large gathering at the institute/conference.
- CO2 - Collect relevant and updated research-based data and information to prepare a paper of seminar presentation.
- CO3 - Apply presentation skills.
- CO4 - Create conducive environment for learning and discussion through seminar presentation.
- CO5 - Identify a problem statement and establish the action plan for the successful completion of the project.

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 Mark
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min		
315003	SEMINAR AND PROJECT INITIATION COURSE	SPI	AEC	-	-	1	2	3	1	-	-	-	-	-	25	10	25@	10	25	10	75	

V. General guidelines for SEMINAR and Project Initiation

- The seminar must be related to emerging trends in engineering / technology programme or may be inter/ multi-disciplinary, based on industry expected outcomes of the programme.
- The individual students have different aptitudes and strengths. Therefore, SEMINAR should match the strengths of students. For this purpose, students shall be asked to select the TITLE (Theme)of SEMINAR they would like to prepare and present.
- Seminar titles are to be finalized in consultation with the faculty mentor.

- Seminar must involve logic development of applications of various technologies/ processes applicable in industry.
- Seminar must be assigned to the single student. However, support of other students may be sorted while presenting the seminar
- Students are required to prepare using relevant software tools, write ups for presentation
- Students shall submit One Hard copy and one Soft copy each of the presentation and may be encouraged to keep a recorded copy of t presentation made during the seminar.
- Batch of 3-4 students shall be formed for project initiation.
- Projects give a platform for the students to showcase an attitude of inquiry to identify the problem statement related to the programm Students shall Identify the information suggesting the cause of the problem and possible solutions
- Students shall study and assess the feasibility of different solutions and the financial implications.
- Students should collect relevant data from different sources (books/internet/market/suppliers/experts through surveys/interviews).
- Students shall prepare required drawings/ designs and detailed plan for the successful execution of the work.
- Students may visit the organisation pertaining to the problem statement as part of initial study.

VI.Guidelines for Seminar preparation and presentation :

Once the title/topic of a seminar has been finalized and allotted to the student, the teacher's role is important as guide, mentor and motivator, to promote learning and sustain the interest of the students.

Following should be kept in mind while preparing and presenting the seminar:

- **Seminar Orientation cum -briefing**: the seminar topics/themes should be innovative, novel and relevant to the curriculum of the programme, and also aligned to the expectations of industry.
- **Seminar Literature surve**y: Information search and data collection: the information and data should be authentic, realistic and relev to the curriculum of the programme.
- **Seminar Preparation, and presentation**: The seminar shall be present with suitable software tools and supporting handout/notes. T presentation of seminar should not be more than 20 minutes including Q-A session.

The following guidelines may be followed for Project Initiation

- **Establishing project scope:** Determine the boundaries of the project.
- **Defining project objectives:** Set clear and measurable objectives that align with the project's purpose.
- **Stakeholder identification and analysis:** Perform an exercise in identifying all stakeholders involved in the project and analyzing th needs and expectations.
- **Team Formation:** Carefully build a team with the necessary skills and expertise to execute the project successfully.
- **Documentation.** Create a project planner showcasing the action plan, define the project's scope, outline the project definition, and design of the project. The document has to be made available to all stakeholders

VII. Criteria of Assessment /Evaluation of Seminar

A. Formative Assessment (FA) criteria

The assessment of the students in the fifth semester Progressive Assessment (PA) for 50 marks is to be done based on following crite

A. Suggestive RUBRICS for assessment

Sr. No.	Criteria	Marks
1	Selection Topic/Theme of seminar	05
2	Literature review and data presentation	05
3	Quality of Preparation and innovativeness	05
4	Q-A handling	05
5	Time Management	05
6	Seminar Presentation report	10

Rubrics for assessment of Project Initiation

Sr. No.	Criteria	Marks
1	Selection of Theme of Problem Statement and its innovativeness	05
2	Stages of development of Action plan	05
3	Prototyping	05

The total marks as per above out of 50, shall be converted in proportion of 25 marks.

B. Summative Assessment criteria/

The summative assessment of the students in the fifth semester End-Semester-Examination (ESE) for 50 marks is to be done based on following criteria.
This assessment shall be done by the Faculty.

Suggestive **RUBRICS** may be developed by the faculty

Sr. No.	Criteria	Marks
1	Quality of information/Knowledge presented in SEMINAR	10
2	Creativity, Innovation in SEMINAR presentation	10
3	Response to the question during seminar presentation	10
4	Establishment of Innovative Problem Statement and its presentation	10
5	Objectives of the project and action plan	10

The total obtained marks shall be converted in proportion of 25 marks.

VIII. Suggestive CO-PO Mapping

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**
CO-1	3	1	0	-	2	2	3		
CO-2	2		2	-	2	1	3		
CO-3	3	1	1	2	1	2	3		
CO-4	2	0	0	2	1	2	3		
CO-5	3	3	3	2	2	3	3		

VIII.Typographical instructions/guidelines for seminar preparation & presentation

- The seminar PPT shall be computer typed (English- British)
- Text Font -Times New Roman (TNR), Size-12 point
- Subsection heading TNR- 12 point bold normal
- Section heading TNR- 12 capital bold
- Chapter Name/ Topic Name – TNR- 14 Capital
- All text should be justified. (Settings in the Paragraph)
- Different colors text/diagrams /tables may used
- The name of the candidate, diploma (department), year of submission,name of the institute shall be printed on the first slide of PPT.

IX.Seminar and Project Initiation Report
On completion and presentation of Seminar, every student will submit a brief report which should contain the following:

- Cover Page (as per annexure 1)
- Title page (as per annexure 2)
- Certificate by the Guide (as per annexure 3)
- Acknowledgment (The candidate may thank all those who helped in the execution of the project).
- Abstract of Paper presented in the seminar (It should be in one page and include the purpose of the seminar & methodology if a .)
- Index

- List of Figures
- Introduction
- Literature Review
- Information/Chapters related to Seminar topic
- Advantages and Disadvantages
- Conclusion
- Project Initiation : a) Description of problem statement. b) Scope and objectives. c) State holder d) Platform/ Equipment/ Resou identification.
- Bibliography
- References

NOTE: Seminar report must contain only relevant – technology or platform or OS or tools used and shall not exceed 25-30 pages.

Details of Softcopy to be submitted:
The soft copy of seminar presentation is required to be provided on the back cover of the seminar report in clear packet, which shoul include the following folders and contents:

1.Presentation (should include a PPT about project in not more than 15 slides)
2.Documentation (should include a word file of the project report)

NOTE: Soft copy must be checked for any harmful viruses before submission.

X. Sample Formats

1) Cover Page - Annexure-I

2) Index - Annexure-II

3) Assessment - Annexure-III

Annexure - I

MSBTE LOGO

SEMINAR Report

Institute Logo

"SEMINAR Title_ _ _ _ _ _ _ _ _ _ _ _ _"

as a partial fulfilment of requirement of the

THIRD YEAR DIPLOMA IN

Submitted by

Name of Student **Enrollment Number**

FOR THE ACADEMIC YEAR 20___20___

(H.O.D) **(Principal)**

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

Annexure - II

Institute Name

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

Table of Contents

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

Annexure - III

Format for SEMINAR and PROJECT INITIATION Assessment /Evaluation

Formative Assessment

CRITERIA AND WEIGHTAGE

Enrollment No	**1** Selection Topic/Theme of seminar (5)	**2** Literature review and data presentation (5)	**3**. Quality of Preparation and innovativeness (5)	**4** Q-A handling (5)	**5** Time Management (5)	6. Seminar Presentation report (10)	**7** Selection of Theme of Problem Statement and its innovativeness (5)	**8** Stages of development of Action plan (5)	**9.** Prototyping (5)	**10.** Total (50)	Sc to (

SummativeAssessment

CRITERIA AND WEIGHTAGE

Enrollment No	**1.** Quality of information/Knowledge presented in SEMINAR **10**	**2** Creativity, Innovation in SEMINAR presentation 10	**3**. Response to the question during seminar presentation 10	**4** Establishment of Innovative Problem Statement and its presentation 10	**5** Objectives of the project and action plan 10	Total **(50)**	Scaled to **(25)**

Sign: **Name: ----------** **(Course Expert/s)**	**Sign:** **Name: ----------** **(Program Head)** **(Information Technology)**

Programme Name/s	**: Automobile Engineering./ Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Production Engineering/ Computer Science/ Electronics & Computer Engg.**
Programme Code	**: AE/ AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ ME/ MK/ PG/ SE/ TE**
Semester	**: Fifth**
Course Title	**: INTERNSHIP(12 WEEKS)**
Course Code	**: 315004**

I. RATIONALE

Globalization has prompted organizations to encourage skilled and innovative workforce. Internships are educational and career development opportunities, providing practical/ hands-on experience in a field or discipline. Summer internship is an opportunity for students to get accustomed to modern industry practices, apply the knowledge and skills they've acquired in the classroom to real-world situations and become familiar with industry environments before they enter the professional world. Keeping this in mind, industrial training is incorporated to all diploma programmes as it enables the student to get equipped with practical skills, soft skills and life skills

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Apply skills and practices to industrial processes.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Observe time/resource management and industrial safety aspects.
- CO2 - Acquire professional experience of industry environment .
- CO3 - Establish effective communication in working environment.
- CO4 - Prepare report of assigned activities and accomplishments.

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	
315004	INTERNSHIP(12 WEEKS)	ITR	INP	-	-	-	-	36 - 40	10	-	-	-	-	-	100	40	100#	40	-	-	200

Legends: # External Assessment

Note: Credits for Industrial Training are in-line of guidelines of NCrF : The industrial training is of 12 weeks considering 36-40 hours per week engagement of students (as per Guidlines of GR of Maharashtra Govt.) under Self Learning with guidance of industry supervisor / Mentor

V General guidelines for organizing Industrial training

The Industry/organization selected for Industrial training/ internships shall be Government/Public Limited/ Private limited / Startup /Centre of Excellence/Skill Centers/Skill Parks etc.

1. Duration of Training - 12 weeks students engagement time
2. Period of Time slot - Between 4th and 5th semester (12 weeks) i.e. commencement of internships will be immediately following the 4th semester exams.
3. Industry area - Engineering Programme Allied industries of large, medium or small-scale, Organization/Govt./ Semi Govt Sectors.

VI Role(s) of Department at the Institute:

Following activities are expected to be performed by the concerned department at the Polytechnics.

Table of activities to be completed for Internship

S.No	Activity	Suggested Schedule WEEKS
1	Collection of information about industry available and ready for extending training with its offered capacity of students (**Sample Format 1**)	1st to 3rd week of 4th Semester
2	Allocations of Student and Mentor as per availability (Mentor: Student Ratio (1:15)	4th to 6th week of 4th semester
3	Communication with Industry and obtaining its confirmation Sample letter Format	6th to 8th week of 4th semester
4	Securing consent letter from parents/guardians of students (Sample Format 2)	Before 10th week of 4th semester
5	Enrollment of Students for industrial training (Format 3)	Before 12th week of 4rd semester
6	Issue of letter to industry for training along with details of students and mentor (Format 4)	Before 14th week of 4th Semester

7	Organize Internship Orientation session for students	Before end of 4th Semester
8	Progressive Assessment of industry training by Mentor	Each week during training period
9	Assessment of training by institutional mentor and Industry mentor	5th Semester ESE

Suggestions-

1. Department can take help of alumina or parents of students having contact in different industries for securing placement.
2. Students would normally be placed as per their choices, in case of more demand for a particular industry, students would be allocated considering their potentials. However preference for placement would be given to students who have arranged placement in company with the help of their parents or relatives.
3. Principal/HOD/Faculty should address students about industrial safety norms, rules and discipline to be maintained in the industry during training before relieving students for training.
4. The faculty members during the visit to industry or sometimes through online mode will check the progress of the student in the training, student attendance, discipline, and project report preparation each week.

VII Roles and Responsibilities of students:

1. Students may interact with the mentor to suggest choices for suitable industry, if any. If students have any contact in industry through their parents or relatives then the same may be utilized for securing placement for themselves and their peers.
2. Students have to fill the forms/formats duly signed by institutional authorities along with a training letter and submit it to a training officer/mentor in the industry on the first day of training.
3. Students must carry with him/her Identity card issued by the institute during the training period.
4. Students should follow industrial dressing protocols, if any. In absence of specific protocol students must wear college uniform compulsorily.
5. Students will have to get all necessary information from the training officer/mentor at industry regarding schedule of training, rules and regulation of the industry and safety norms to be followed. Students are expected to observe these rules, regulations and procedures.
6. Students must be fully aware that if they disobey any rule of industry or do not follow the discipline then non-disciplinary action will be taken .
7. Students must maintain a weekly diary (**Format 6**) by noting daily activities undertaken and get it duly signed from industry mentor or Industrial training in charge.
8. In case students face any major problems in industry such as an accident or any disciplinary issue then they should immediately report the same to the mentor at the institute.

9. Prepare a final report about the training for submitting to the department at the time of presentation and viva-voce and get it signed from a mentor as well as industry training in charge.

10. Students must submit the undertaking as provided in **Format 5**.

VIII Typographical guidelines for Industry Training report

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

1. The training report shall be computer typed (English- British) and printed on A4 size paper.

2. Text Font -Times New Roman (TNR), Size-12 point

3. Subsection heading TNR- 12 point bold normal

4. Section heading TNR- 12 capital bold

5. Chapter Name/ Topic Name – TNR- 14 Capital

6. All text should be justified. (Settings in the Paragraph)

7. The report must be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.

8. The training report must be hardbound/ Spiralbound with a cover page in black color. The name of the candidate, diploma (department), year of submission, name of the institute shall be printed on the cover.

9. The training report, the title page should be given first then the Certificate followed by the acknowledgment and then contents with page numbers.

IX Suggestive format of industrial training report

Following format may be used for training report. Actual format may differ slightly depending upon the nature of Industry/ Organization.

- Title Page
- Certificate
- Abstract
- Acknowledgement
- Content Page

Chapter 1	Organization structure of Industry and general layout.
Chapter 2	Introduction to Industry / Organization (history, type of products and services, turn over and number of employees etc.)
Chapter 3	Types of Major Equipments/raw materials/ instruments/machines/ hardware/software used in industry with their specifications, approximate cost, specific use and routine maintenance done
Chapter 4	Processes/ Manufacturing Manufacturing techniques and methodologies and material handling procedures
Chapter 5	Testing of Hardware/Software/ Raw materials/ Major material handling product (lifts, cranes, slings, pulleys, jacks, conveyor belts etc.) and material handling procedures.
Chapter 6	Safety procedures followed and safety gears used by industry.

Chapter 7	Particulars of Practical Experiences in Industry/Organization if any in Production/Assembly/Testing/Maintenance
Chapter 8	Detailed report of the tasks undertaken (during the training).
Chapter 9	Special/challenging experiences encountered during training if any (may include students liking & disliking of workplaces).
Chapter 10	Conclusion
Chapter 11	References / sources of information

X Suggested learning strategies during training at Industry

- Students should visit the website of the industry where they are undergoing training to collect information about products, processes, capacity, number of employees, turnover etc.
- They should also refer to the handbook of the major machines and operations, testing, quality control and testing manuals.
- Students may also visit websites related to other industries wherein similar products are being manufactured.

XI Tentative week wise schedule of Industry Training

Industrial training is a common course to all Diploma programmes , therefore the industry selection will depend upon the nature of the programme and its related industry. The training activity may vary according to nature and size of industry.

The following table details of activities to be completed during industrial training.

Details of Activities to be completed during Industry training
Introduction of Industry and departments.
Study of Layout of Industry, Specifications of Machines , raw materials, components available in the industry
Study of setup and manufacturing processes
Execute given project or work assigned to the students, study of safety and maintenance procedures
Validation from industry mentor regarding project or work allocated
Report writing

XII CO-PO Mapping Table to be created by respective Department/faculty.

XIII. Formative Assessment of training : Suggested RUBRIC

(Note : Allot the marks in proportion of presentations and outcome observed. Marks excluding component of week 11 are to be filled by Institute mentor)

Week No	**Task to be assessed**	**Outcome Achievement - Poor**	**Outcome Achievement - Moderate**	**Outcome Achievement - High**		**Week-wise total Marks**
		Poor Marks	Average Marks	Good Marks	Excellent Marks	

1	Introduction of Industry	Minimal Knowledge of Departments, processes, products and work culture of the company **(Marks –1)**	Moderate Knowledge of Departments, processes, products and work culture of the company **(Marks –2)**	Good Knowledge of Departments, processes, products and work culture of the company **(Marks –3/4)**	Extensive Knowledge of Departments, processes, products and work culture of the company **(Marks –5)**	
2	Presentation of Layout of Industry, Specifications of Machines, raw materials, components available in the industry	Minimal w.r.t. tasks **(Marks –1)**	Moderate w.r.t. tasks **(Marks –2)**	Good w.r.t. tasks **(Marks –3/4)**	Extensive w.r.t. tasks **(Marks –5)**	
3	Participation in setup and manufacturing processes/platforms	Minimal Participation with poor understanding **(Marks –1-8)**	Moderate Participation with poor understanding **(Marks –9-12)**	Good Participation with poor understanding **(Marks –13-17)**	Extensive Participation with poor understanding **(Marks –18-20)**	
4 to 10	Execution of given project or work to the students, Follow of safety and maintenance procedures	Minimal Participation with poor understanding **(Marks –1-8)**	Moderate Participation with lower level understanding **(Marks – 9-12)**	Good Participation with Good understanding **(Marks – 13-17)**	Extensive Participation with excellent understanding **(Marks – 18-20)**	
11	Validation by industry mentor regarding project or work allocated	Minimal Participation with poor performance **(Marks –1-10)**	Moderate Participation with acceptable performance **(Marks – 11-15)**	Good Participation with Good performance **(Marks – 16-20)**	Extensive Participation with excellent performance **(Marks – 21-25)**	
12	Diary writing	• Results are not Presented properly, • Project work is summarized and concluded not acceptable • Future extensions are not specified **(Marks –1-10)**	• Results are Presented just casually • Project work is summarized and concluded casually • Future extensions are casually specified **(Marks –11-15)**	• Results are Presented well and properly, • Project work is summarized and concluded to a Good level • Future extensions are well specified **(Marks –16-20)**	• Results are Presented exhaustively • Project work is summarized and elaborated in excellent manner , concluded • Future extensions are excellently specified **(Marks –21-25)**	

Total Out of :100	

Marks for (FA) are to be awarded for each week considering the level of completeness of activity observed as per table specified in Sr.No. XIII above, from the daily diary maintained . Feedback from industry supervisor shall also be considered.

XIV Summative Assessment (SA) of training:

Academic year : 20 -20

i) Suggested RUBRIC for SA

	Observations from Orals				**Presentations**				**Total (100)**
Enrollment Number	Tasks undertaken (20)	Overall Understanding (20)	Creativity /Innovation demonstrated (10)	Knowledge acquired (10)	Speech Clarity (10)	Body Language (10)	Presentations (10)	Diary , Report writing and / Product (10)	

Name of mentor:
Signature of Mentor

XV FORMATS

Format-1: Collecting Information about Industry/Organization available for training along with capacity

1) Name of the industry/organization:
2) Address/communication details with email :
3) Contact person details:
   a) Name:
   b) Designation:
   c) Email
   d) Contact number/s:

4) Type:

   Govt / PSU / Pvt /

   Large scale / Medium scale / Small scale …..

5) Products/services offered by industry:

6) a) Whether willing to offer Industrial training facility during May/ June for Diploma in Engineering students: **Yes / No.**
   b) If yes, whether you offer 12 weeks training: **Yes/No**
   c) Possible Industrial Capacity:

Students	Programme name/ Title					Total
	Civil	Mechanical	Chemical			
Male						
Female						
Total						

7) Whether accommodation available for interns **Yes / No.**
If yes capacity:_____

8) Whether internship is charged or free:
If charged please specify amount per candidate: _____

Signature of responsible person at Industry:

Format-2: Obtaining Consent Letter from parents/guardians

(Undertaking from Parents)

To,

The Principal,
_____,

Subject: Consent for Industrial Training.
Sir/Madam,

I am fully aware that -

i) My ward studying in _____ semester at your _____ institute has to undergo 12 weeks of Industrial training for partial fulfillment towards completion of Diploma in _____ Engineering.

ii) For this fulfillment he/she has been deputed at_____ industry, located at _____ for Industrial training /internship for the period from _____ to _____ .

With respect to above I give my full consent for my ward to travel to and from the mentioned industry. Further I undertake that –

a) My ward will undergo the training at his/her own cost and risk during training and/or stay.
b) My ward will be entirely under the discipline of the organization where he/she will be placed and will abide by the rules and regulations in face of the said organization.
c) My ward is NOT entitled to any leave during the training period.
d) My ward will regularly submit a prescribed weekly diary, duly filled and countersigned by the training supervisor of the organization to the mentor faculty of the polytechnic.

I have explained the contents of the letter to my ward, who has also promised to adhere strictly to the requirements. I assure that my ward will be properly instructed to take his own care to avoid any accidents/injuries in the industry. In case of any accident neither industry nor the institute will be held responsible.

Signature :
Name : _____
Address : _____

Phone Number :

Format-3: Students Enrollment for Industrial Training

(Academic Year –)

Sr No	Enrollment Number	Name of Student	Name of Industry	Name of Mentor at Institute

Format-4: Issue Letter to the Industry/Organization for the training along with details of students and mentors

To,

The HR Manager,

_____

Subject: Placement for Industrial training of ___ weeks in your organization….

Reference: Your consent letter no: ….

Sir,

With reference to the above we are honored to place the following students from this institute for Industrial training in your esteemed organization as per the arrangement arrived at.

The purpose of this training is to equip the student with some essential skills relevant to the demands of the industry and world of work, as well as to provide exposure to the professional environment and work culture. It is hoped that this training may enhance his/her employability and livelihood opportunities. In view of the above, we kindly request your support in facilitating this Industrial Training for the student. He/she has been adequately oriented and guided on the expectations of this training, including the maintenance of a daily diary during the training period. Additionally, the institute has secured the necessary consent and undertaking from the parent/guardian regarding the guidelines for exit training. In view of all the above industry shall refrain from involving students into the mundane and housekeeping activities. Your cooperation in this regard will be highly appreciated.

Diploma programme in _____ Engg.

Sr.No	Enrollment No	Name of Student	Name and designation of Mentor

Diploma programme in _____ Engg.

Sr.No	Enrollment No	Name of Student	Name and Designation of Mentor

Kindly extend all possible cooperation to the students for above.

Thanking you

Yours sincerely,

(Principal)
Name of the Institute:
with Seal

Cc- To HoD/Mentor

Format-5: Undertaking by the students

TO

Principal

Subject: Undertaking regarding Placement for Industrial training of 12/16/18 weeks duration

I ……Reg No:…….. S/o/D/o. ……Studying in ---------- ---------- at ---------- Institute at ----------fully aware of the Industrial Training requirement and related responsibilities and participation in the ……, Industrial training between From: …… To……..

I assure you that I will be of good behavior and be obedient to the staff and mentor during the ……/Industrial training. I will also abide and will not participate in all activity. I will also discipline myself within the rules and regulations of the Institution. I am also aware that I am participating in the …….. at my own risk and I will not hold the ----------Institute responsible in any way in any eventuality namely Accident /Injury/death or whatever mishap and I myself will be solely responsible for my safety.

Place :Signature of the student

Date :Reg. No.

Format-6: Internships Daily Diary

Name of the Student: _____ Name of the mentor (Faculty) : _____

Enrollment Number: _____ Semester: _____ Academic Year _____

Week	Day & Date	Discussion Topics/Activity	Details of Work Allotted Till Next Session /Corrections Suggested/Faculty Remarks	Signature of Industry Mentor
Week 01	Mon, Date			
	Tue, Date			
	Wed, Date			
	Thu, Date			
	Fri, Date			
	Sat, Date			
.	Mon, Date			
	Tue, Date			
.	Wed, Date			
	Thu, Date			
.	Fri, Date			
.	Sat, Date			
Week n	Mon, Date			
	Tue, Date			
	Wed, Date			
	Thu, Date			
	Fri, Date			
	Sat, Date			

OPERATING SYSTEM **Course Code : 315319**

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**
Programme Code	**: AI/ AN/ BD/ CM/ CO/ CW/ DS/ HA/ IF/ IH/ SE**
Semester	**: Fifth**
Course Title	**: OPERATING SYSTEM**
Course Code	**: 315319**

I. RATIONALE

An Operating System is to manage a Computer Hardware and software resources efficiently and provide user friendly environment. An Operating System is a System Program that controls the execution of application program and acts as an interface between applications and the computer hardware. It also place a curtail role in maintaining system security, protecting data and ensuring that processes do not interfere with one another. This course enables to learn internal functioning of Operating System and will help in identifying appropriate Operating System for given Application/Task.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Interpret features of Operating System.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Explain the services and components of an Operating System.
- CO2 - Describe the different aspects of Process Management in an Operating System.
- CO3 - Implement various CPU Scheduling algorithms and evaluate their effectiveness.
- CO4 - Analyze the Memory Management techniques used by an Operating System.
- CO5 - Apply techniques for effective File Management in an Operating System.

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	
315319	OPERATING SYSTEM	OSY	DSC	5	-	2	2	9	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.* 10 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 functions of an Operating System. TLO 1.2 Explain different services of Operating System. TLO 1.3 Explain use of system call of Operating System. TLO 1.4 Explain activities of Operating System in concern with their components.	**Unit - I Operating System services and components** 1.1 Operating System: concept, functions 1.2 Different types of Operating System: Batch Operating System, Multi-programmed, Time Shared Operating System, Multiprocessor System, Distributed System, Real Time System, Mobile OS (Android OS) 1.3 Command line based Operating System: DOS, UNIX GUI based Operating System: WINDOWS, LINUX, MaC OS 1.4 Different Services of Operating System, System Calls: Concept, types of system calls 1.5 Operating System Components: Process Management, Main Memory Management, File Management, IO Management, Secondary Storage Management	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.
2	TLO 2.1 Explain the different states of a process. TLO 2.2 Describe the functions of different component of process stack in PCB (Process Control Block). TLO 2.3 Explain multiple processes access shared resources without interfering each other. TLO 2.4 Compare Multithreading models.	**Unit - II Process Management** 2.1 Processes: process state, process control block 2.2 Process Scheduling: scheduling queues, types of schedulers, context switch 2.3 Inter Process Communication: Shared memory system, Message passing system 2.4 Threads: Benefits, User and Kernel level threads, Multithreading Models: One to One, Many to One, Many to Many 2.5 Execute process commands like: top, ps, kill, wait, sleep, exit, nice	Lecture Using Chalk-Board Presentations
3	TLO 3.1 Justify the need of given scheduling criteria with relevant example. TLO 3.2 Explain with example the procedure of allocating CPU to the given process. TLO 3.3 Calculate turnaround time and average waiting time of the given scheduling algorithm. TLO 3.4 Explain functioning of the given necessary conditions leading to Deadlock.	**Unit - III CPU Scheduling** 3.1 Scheduling: Basic concept, CPU and I/O burst cycle 3.2 Preemptive and Non-preemptive scheduling, scheduling criteria 3.3 Types of Scheduling algorithms: First Come First Serve(FCFS), Shortest Job First (SJF), Shortest Remaining Time Next (SRTN), Round Robin (RR), Priority Scheduling, Multilevel Queue Scheduling 3.4 Deadlock: System Models, Necessary conditions Leading to Deadlock, Deadlock Handling: Deadlock prevention, Deadlock avoidance- Banker’s Algorithm	Presentations Lecture Using Chalk-Board
4	TLO 4.1 Compare fixed and variable memory partitioning. TLO 4.2 Differentiate between Bit map and Linked list technique. TLO 4.3 Explain working of various partitioning algorithm. TLO 4.4 Calculate page fault for given page reference string.	**Unit - IV Memory Management** 4.1 Basic Memory Management: Partitioning - Fixed and Variable, Free Space Management Techniques: Bit map, Linked List 4.2 Swapping, Compaction, Fragmentation, Partitioning Algorithms: First fit, Best fit, Worst fit 4.3 Non-contiguous Memory Management Techniques: Paging, Segmentation 4.4 Virtual Memory: Basics, Demand paging, Page Fault 4.5 Page Replacement Algorithm: First In First Out (FIFO), Least Recently Used (LRU), Optimal	Lecture Using Chalk-Board Presentations Video Demonstrations
5	TLO 5.1 Explain structure of the given file system with example. TLO 5.2 Describe mechanism of file access method. TLO 5.3 Explain procedure to create access directories and assign the given file access permissions.	**Unit - V File Management** 5.1 File Concepts: Attributes, Operations, File types and File system structure 5.2 Accessing Methods: Sequential, Direct 5.3 File Allocation Methods: Contiguous allocation, Linked allocation, Indexed allocation 5.4 Directory Structure: Single level, Two level, Tree structured Directory	Presentations Lecture Using Chalk-Board

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

OPERATING SYSTEM **Course Code : 315319**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Execute the system call commands.	1	* System call commands in Linux such as fork(), exec(), getpid, pipe, exit, open, close, stat, uname.	2	CO1
LLO 2.1 Execute process related commands.	2	* Process related commands in Linux - top, ps, kill, wait, sleep, nice, renice,bg,fg.	2	CO2
LLO 3.1 Execute message passing and shared memory commands.	3	* a. Commands for Sending Messages to Logged-in Users -who, cat, wall, write, mesg. * b. List Processes Attached to a Shared Memory Segment: ipcs.	2	CO2
LLO 4.1 Implement First Come First Serve (FCFS) Scheduling algorithm.	4	* Write a C/Python program to calculate average waiting time and Turnaround Time of n processes with First Come First Serve (FCFS) CPU scheduling algorithm.	2	CO3
LLO 5.1 Implement Shortest Job First (SJF) Scheduling algorithm.	5	Write a C/Python program to calculate average waiting time and Turnaround Time of n processes with Shortest Job First (SJF) CPU scheduling algorit hm.	2	CO3
LLO 6.1 Implement Priority Scheduling algorithm.	6	Write a C/Python program to calculate average waiting time and Turnaround Time of n processes with Priority CPU scheduling algorithm.	2	CO3
LLO 7.1 Implement Round Robin (RR) Scheduling algorithm.	7	Write a C/Python program to calculate average waiting time and Turnaround Time of n processes with Round Robin (RR) CPU scheduling algorithm.	2	CO3
LLO 8.1 Implement Banker's algorithm for deadlock avoidance.	8	Write a C/Python program to implement Banker's Algorithm.	2	CO3
LLO 9.1 Execute memory management commands.	9	Basic memory management commands - df, free, vmstat, /proc/meminfo, htop.	2	CO4
LLO 10.1 Implement First In First Out (FIFO) Page Replacement algorithm .	10	* Write a C/Python program on First In First Out (FIFO) Page Replacement algorithm.	2	CO4
LLO 11.1 Implement Least Recently Used (LRU) Page Replacement algorithm.	11	Write a C/Python program on Least Recently Used (LRU) Page Replacement algorithm.	2	CO4
LLO 12.1 Implement sequential file allocation method.	12	* Write a C/Python program on sequential file allocation method.	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

- Find out the total number of page faults using – i) First In First Out ii) Least recently used page replacement ii) Optimal page replacement Page replacement algorithms of memory management, if the page are coming in the order 7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1
- Compare between CLI based Operating System and GUI based Operating System.
- Differentiate between process and thread (any two points). Also discuss the benefits of multithreaded programming.
- Enlist different file allocation methods? Explain contiguous and indexed allocation method in detail.

Micro project

- Create a report depicting features of different types of operating systems- Batch operating system, Multi programmed, Time shared, Multiprocessor systems, Real time systems, Mobile OS with examples.
- Implement and Compare Memory Allocation Strategies - First Fit, Best Fit, Worst Fit
- Create a report on different operating system tools used to perform various functions.

Self learning

- Complete any one course related to the operating system on MOOCS such as NPTEL, Coursera, Infosys Springboard etc.

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 with basic configuration. Linux or alike operating system such as Ubuntu, CentOS 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	Operating System services and components	CO1	10	2	8	4	14
2	II	Process Management	CO2	10	4	4	6	14

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
3	III	CPU Scheduling	CO3	10	2	6	8	16
4	IV	Memory Management	CO4	12	2	6	8	16
5	V	File Management	CO5	8	2	4	4	10
Grand Total				**50**	**12**	**28**	**30**	**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 1) 60% weightage is to process 2) 40% weightage to product

Summative Assessment (Assessment of Learning)

- End Semester Examination, Lab Performance, Viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Dhananjay M. Dhamdhere	Operating System: A Concept-Based Approach	McGraw Hill Education 3rd edition, ISBN: 978-1259005589
2	William Stallings	Operating Systems : Internals and Design Principles	Pearson Education 9th Edition, ISBN: 978-9352866717
3	Richard Petersen	Linux The Complete Reference	McGraw Hill, 6th edition, ISBN: 978-0071492478
4	Richard Blum	Linux command line and shell scripting	Wiley India, ISBN: 978-1118983843

Sr.No	Author	Title	Publisher with ISBN Number
5	Abraham Silberschatz and James Peterson	Operating System Concepts	Wiley India, ISBN: 9781119454083

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/106/105/106105214/	Introduction to Operating System
2	https://www.geeksforgeeks.org/processes-in-linuxunix/	Process Related commands
3	https://ubuntu.com/download/desktop	Installation of Ubuntu
4	https://developers.redhat.com/products/rhel/download	RedHat Linux download
5	https://www.digitalocean.com/community/tutorials/linux-commands	Basic Linux commands
6	https://www.geeksforgeeks.org/what-is-an-operating-system/	Operating System

Note :

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

ADVANCE COMPUTER NETWORK **Course Code : 315321**

Programme Name/s	**: Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Computer Hardware & Maintenance/ Information Technology/ Computer Science**
Programme Code	**: BD/ CM/ CO/ CW/ HA/ IF/ SE**
Semester	**: Fifth**
Course Title	**: ADVANCE COMPUTER NETWORK**
Course Code	**: 315321**

I. RATIONALE

The Advance Computer Network course provides a comprehensive exploration of networking concepts and technologies. It covers Internet architecture, IP addressing, routing protocols (RIP, OSPF, BGP), TCP/UDP, DNS, and advanced technologies like SDN, 5G, 6G, and IP security. It equips students with hands-on skills for designing, managing, and troubleshooting modern computer networks.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Implement and optimize network architectures and enhance problem-solving abilities specific to network issues

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Analyze the packet structure of IPv4 and IPv6.
- CO2 - Configure Static and Dynamic Routing Protocols Using Simulators.
- CO3 - Illustrate functions of Transport layer protocols.
- CO4 - Implement Application layer protocols on a network.
- CO5 - Work with various Wireless Networking Technologies.

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	
315321	ADVANCE COMPUTER NETWORK	ACN	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

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.* 10 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 Identify role of ISP and ICANN. TLO 1.2 Compare IPv4 and IPv6. TLO 1.3 Configure Subnets in network. TLO 1.4 Interpret role of ARP and RARP.	**Unit - I Internet Architecture and Network Layer** 1.1 Structure of Internet, Intranet, Role of Internet Service Provider (ISP) and Internet Corporation for Assigned Names and Numbers (ICANN) 1.2 IPv4-Header format, IPv6 -Header format 1.3 Subnet, subnet addressing and address masking, supernetting 1.4 Address Mapping- Address Resolution Protocol (ARP) - Mapping logical to physical addresses, working and message format , Reverse Address Resolution Protocol (RARP) – Mapping physical to logical addresses working and message format	Presentations Video Demonstrations Lecture Using Chalk-Board
2	TLO 2.1 Explain the mechanism of routing. TLO 2.2 Differentiate - Intra and Inter domain routing. TLO 2.3 Explain message structure of ICMP.	**Unit - II Routing Protocols** 2.1 Router architecture, routing table, queueing and switching 2.2 Routing protocols- Intra domain routing- Distance vector routing-Creating distance vector routing tables, Initialization, Sharing, Updating- Routing Information Protocol (RIPv2), Link State Routing-Open Shortest Path First (OSPF)-Types of links, Graphical representation, Inter domain Routing-Path Vector Routing- Border Gateway Protocol (BGPv4) 2.3 Internet Control Message Protocol (ICMP)-Types of messages, Message format, Error reporting messages	Video Demonstrations 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.
3	TLO 3.1 Explain the mechanism of process-to-process delivery. TLO 3.2 Compare multiplexing and demultiplexing. TLO 3.3 Explain functioning of TCP/UDP protocols with example. TLO 3.4 Explain various congestion control methods at Transport layer. TLO 3.5 Describe the functioning of TLS. TLO 3.6 Describe the functioning of SCTP.	**Unit - III Transport Layer Protocols** 3.1 Process to Process Delivery-Client/Server paradigm, Multiplexing and Demultiplexing, Connectionless vs. Connection-Oriented Service 3.2 User Datagram Protocol (UDP)-Ports-Well known ports for UDP header format, features and applications 3.3 Transmission Control Protocol(TCP)-TCP services, TCP features, Segment, Three way handshaking, Flow control, Error control, Congestion control-Open loop, Closed loop 3.4 TLS(Transport Layer Security)-working and applications 3.5 Stream Control Transmission Protocol (SCTP)- services and features	Presentations Flipped Classroom Lecture Using Chalk-Board
4	TLO 4.1 Explain functioning of DNS in internet. TLO 4.2 Explain the components of DNS Architecture. TLO 4.3 Explain the working of Message Transfer Agent. TLO 4.4 Explain the working of Message Access Agent. TLO 4.5 Explain the steps to transfer files using FTP. TLO 4.6 Describe the steps to access remote machine using command line and GUI tool. TLO 4.7 Explain the working of HTTP. TLO 4.8 Explain functions of PGP and allied algorithms.	**Unit - IV Application Layer Protocols** 4.1 Domain Name System (DNS) architecture, Domain types, DNS name space, Domain name resolution & mapping to physical addresses 4.2 Electronic mail i)Message Transfer Agent -Simple Mail Transfer Protocol (SMTP) Components, Working ii)Message Access Agent - Post Office Protocol (POP) and Internet Message Access Protocol (IMAP) 4.3 File Transfer Protocol (FTP), Anonymous FTP 4.4 Remote logging: Telnet, Remote Desktop 4.5 World Wide Web (WWW) and Hyper Text Transfer Protocol (HTTP)- Architecture, Types of web documents, HTTP transaction 4.6 Pretty Good Privacy (PGP)-Security Parameters, Services, A Scenario or Overview of -PGP algorithms, Key rings, PGP certificates	Presentations Video Demonstrations 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.
5	TLO 5.1 Compare the characteristics of 3G, 4G, 5G TLO 5.2 Illustrate SDN Architecture. TLO 5.3 Explain Network Functions Virtualization. TLO 5.4 Describe the role of Edge Computing and Edge Networking. TLO 5.5 Describe role of various Multimedia wireless protocols.	**Unit - V Wireless Network Technologies** 5.1 Wireless Network Communication- 3G, 4G, 5G 5.2 SDN (Software Defined Network)- Architecture, Working, Applications 5.3 Network Functions Virtualization (NFV)-Architecture, Benefits, Applications 5.4 Edge Computing and Edge Networking-Definition, Components, Challenges, Applications 5.5 Multimedia Wireless Networks – Streaming Audio and Video, Voice Over Internet Protocol (VoIP), Protocols – Real-time Transport Protocol(RTP), Real-Time Streaming Protocol (RTSP)	Presentations Lecture Using 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 Describe each component of output of WHOIS command LLO 1.2 Configure a network by assigning IP addresses and subnet masks.	1	*a)Identify IP allocations and Internet Service Providers for a student network Using WHOIS. b)Set up IP addresses and subnet masks on given network devices	2	CO1
LLO 2.1 Troubleshoot network problems.	2	Identify and resolve network issues using network diagnostic tools like ping, tracert, show,debug commands.	2	CO1
LLO 3.1 Develop and run a network communication script to monitor network communication at IP layer.	3	Run a Network Communication Script on "Kali Linux"	2	CO1
LLO 4.1 Implement Routing Protocols.	4	*Configure basic routing protocols using any relevant software/virtual lab.	2	CO2
LLO 5.1 Tabulate and interpret the captured ICMPv4 packet parameters using relevant network analysis software.	5	Capture and Analyze ICMPv4 Packets using appropriate tool	2	CO2
LLO 6.1 Create and troubleshoot TCP and UDP connections.	6	*Configure, diagnose and troubleshoot TCP and UDP connection issues using diagnostic tools like netstat, wireshark, iperf	2	CO3
LLO 7.1 Setup Domain Name Server (DNS).	7	*Configure DNS using relevant software.	2	CO4
LLO 8.1 Configure and Test File Transfer Protocol (FTP).	8	*Configure FTP using relevant software	2	CO4
LLO 9.1 Inspect and debug HTTP traffic.	9	Monitor network traffic using browser developer tools	2	CO4
LLO 10.1 Implement SDN using Mininet.	10	*Design a simple network for SDN using Mininet	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Measure latency and connectivity of wireless network.	11	Using Ping and Latency Tools i)Measure latency and packet loss over time using any suitable tool e.g. PingPlotter ii)Analyze network packets to detect performance bottlenecks using any suitable tool e.g.Wireshark	2	CO5
LLO 12.1 Capture and analyze traffic for multimedia applications over internet.	12	Multimedia traffic analysis i)Capture and analyze HTTP video streaming traffic using any suitable tool e.g.Wireshark ii)Monitor RTP (Real-time Transport Protocol) packets from a multimedia stream using any suitable tool e.g.Wireshark	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

- Explain the basic principles of wireless communication, including the electromagnetic spectrum, frequency bands, and signal propagation.
- Explain the structure of an IPv4 address.Include details on network and host portions, classes (A, B, C), and reserved IP addresses.
- Define the key metrics used in routing (e.g., hop count, bandwidth, delay, cost). Explain the effect of these metrics on route selection.
- Outline the step-by-step process of DNS resolution, from entering a domain name in a browser to receiving the corresponding IP address.

Other

- NA

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Wireshark or any other similar software to capture and investigate packets	2
2	Cisco Packet Tracer,MiniNet or any other similar software	4,10
3	Computer system (Any computer system with basic configuration, connected to LAN)	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	Internet Architecture and Network Layer	CO1	6	2	4	6	12
2	II	Routing Protocols	CO2	10	4	4	8	16
3	III	Transport Layer Protocols	CO3	8	2	6	6	14
4	IV	Application Layer Protocols	CO4	8	4	4	6	14
5	V	Wireless Network Technologies	CO5	8	4	4	6	14
Grand Total				**40**	**16**	**22**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- A continuous assessment based on term work.
- Continuous assessment based on process and product related performance indicators.

Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester examination, Lab performance, Viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

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

CO4	1	1	1	2	1	1	1			
CO5	1	1	1	1	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	Forouzan Behrouz A.	Data Communication and Networking 5E	McGraw Hill Education (India), New Delhi, 2005, ISBN-13:978-1-25-906475-3
2	Comer Douglas E.	Internetworking with TCP/IP, Volume I, Fourth Edition.	Prentice Hall of India Private Limited, New Delhi- 110001 ISBN-81-203-2065-4
3	Forouzan Behrouz A.	TCP/IP Protocol Suite	Tata McGraw-Hill Edition, New Delhi ISBN-0-07-043474-3
4	Tanenbaum Andrew S. ,Nick Feamster,David J. Wetherall	Computer Networks, Sixth Edition	Pearson ISBN-13: 9780136764052
5	B.M. Harwani & DT Editorial Services	Advanced Computer Network	Dreamtech ISBN 978-93-5004-013-3
6	Computer Networks Principles, Technologies And Protocols For Network Design	Natalia Olifer, Victor Olifer	Wiley ISBN
7	Thomas D. Nadeau, Ken Gray	SDN: Software Defined Networks	O'Reilly Media, Inc.ISBN: 9781449342302
8	Kurose	Computer Networking, 8th Edition	Pearson Education,ISBN-10 9356061319

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.coursera.org/courses?query=computer%20networks	Offers courses from top universities like Stanford and Princeton on topics like Internet architecture, IP addressing, and advanced networking technologies.
2	https://www.netacad.com/	Offers comprehensive courses on networking, including certifications like CCNA, which cover advanced topics and practical skills.
3	https://www.javatpoint.com/computer-network-tutorial	Focuses on networking tutorials and courses, including detailed lessons on routing protocols, TCP/IP, and advanced networking concepts.
4	https://onlinecourses.nptel.ac.in/noc23_cs35/preview	NPTEL online course for Advance computer Network
5	https://www.geeksforgeeks.org/computer-network-tutorials/	Advance Computer Network concepts tutorial
6	https://www.javatpoint.com/software-defined-networking-sdn-benefits-and-challenges-of-network-virtualization	Software defined network

ADVANCE COMPUTER NETWORK **Course Code : 315321**

Sr.No	Link / Portal	Description
7	https://www.tutorialspoint.com/5g-future-of-wireless-network s	5G

Note :

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

SOFTWARE ENGINEERING **Course Code : 315323**

Programme Name/s	**: Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Computer Hardware & Maintenance/ Computer Science & Information Technology/ Computer Science**
Programme Code	**: CM/ CO/ CW/ HA/ IH/ SE**
Semester	**: Fifth**
Course Title	**: SOFTWARE ENGINEERING**
Course Code	**: 315323**

I. RATIONALE

Software Engineering is the foundation for professional processes to be followed for designing, developing, testing and maintaining software involving principles, different techniques, and practices for software development. This course enable students to develop requisite abilities to follow systemic and disciplined approach to software development that aims to create high quality, reliable and maintainable software.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply software engineering principles to develop software product.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Select suitable software development process model
- CO2 - Prepare software requirement specification.
- CO3 - Construct different Software design models
- CO4 - Apply different planning and cost estimation techniques for a software product
- CO5 - Apply project management techniques in software development.
- CO6 - Use quality assurance principles in software development

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	
315323	SOFTWARE ENGINEERING	STE	DSC	4	-	4	1	9	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.* 10 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 Select the attributes that match with standards for the given software application. TLO 1.2 Suggest the relevant software solution for the given problem. TLO 1.3 Select the relevant software process model for the given problem. TLO 1.4 Suggest the relevant activities in Agile Development Process.	**Unit - I Software Development Process** 1.1 Software characteristics, Types of software. 1.2 The Process: Software Engineering: A Layered approach -Process, Methods and Tools 1.3 Software development framework. 1.4 Software Process Model: Waterfall Model 1.5 Incremental Process Model: RAD Model 1.6 Evolutionary Process Models: Prototyping model, Spiral model 1.7 Agile Process Model: Extreme Programming, Adaptive Software Development (ASD), Scrum, Dynamic System Development Method (DSDM), CRYSTAL. Agile Unified Process (AUP)	Presentations Lecture Using Chalk-Board
2	TLO 2.1 Apply principles of software engineering for the given problem. TLO 2.2 Select the relevant requirement engineering steps for the given problem. TLO 2.3 Construct the Requirement Engineering model for the given problem. TLO 2.4 Prepare SRS for the given problem.	**Unit - II Software Requirement Engineering** 2.1 Software Engineering core principles. 2.2 Software Practices: Communication, Planning, Modelling, Construction, Software deployment (Statement and meaning of each principles for each practice). 2.3 Requirement Engineering: Requirement Gathering and Analysis, Types: Functional, Product, organizational, External Requirements, Eliciting Requirements, Developing Use-cases, Building requirement models, Negotiation, Validation. 2.4 Software Requirement Specification: Need, Format, and its Characteristics.	Lecture Using Chalk-Board Presentations Case Study

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 Identify the elements of analysis model for the given software requirements. TLO 3.2 Apply the specified design concepts for software requirements modeling. TLO 3.3 Construct software design using standard design notation. TLO 3.4 State the purpose of software testing. TLO 3.5 Draw Use-Case ,Class Diagrams, Sequence Diagrams for software project. TLO 3.6 Explain basic types of software testing.	**Unit - III Software Modelling and Design** 3.1 Translating Requirement model into design model: Data Modelling. 3.2 Analysis Modelling: Elements of Analysis model. 3.3 Design modelling: Fundamental Design Concepts (Abstraction, Information hiding, Structure, Modularity, Concurrency, Verification, Aesthetics). 3.4 Design notations: Data Flow Diagram (DFD), Structured Flowcharts, Decision Tables. 3.5 UML Modelling :Use-Case ,Class Diagrams, Sequence Diagrams. 3.6 Testing – Meaning and purpose, testing methods - Black-box and White-box, Static and Dynamic testing, Level of testing, V-model.	Lecture Using Chalk-Board Presentations Demonstration
4	TLO 4.1 Explain the management spectrum for software project. TLO 4.2 Estimate size of software product. TLO 4.3 Estimate cost of software product using the empirical method. TLO 4.4 Compute size of the given software using COCOMO model. TLO 4.5 Apply RMMM strategy in Identified risks for any software development problem.	**Unit - IV Software Project Cost Estimation** 4.1 The Management Spectrum – 4P's. 4.2 Metrics for Size Estimation: Line of Code (LoC), Function Points (FP). 4.3 Project Cost Estimation Approaches: Overview of Heuristic, Analytical, and Empirical Estimation. 4.4 COCOMO (Constructive Cost Model), COCOMO II. 4.5 Risk Analysis and Management: Risk identification, Risk assessment, Risk management and monitoring, Risk Refinement and Mitigation, RMMM Plan.	Lecture Using Chalk-Board Presentations Case Study Flipped Classroom
5	TLO 5.1 Apply CPM/PERT scheduling technique for software project. TLO 5.2 Construct timeline chart/ Gantt chart to track progress of the given software project.	**Unit - V Software Project Management** 5.1 Project Scheduling: Basic principles, Work breakdown structure, Activity network 5.2 Project Tracking: Timeline charts, Earned Value Analysis, Gantt Charts. 5.3 Scheduling techniques: Critical Path Method(CPM), Program Evaluation Review Technique(PERT)	Lecture Using Chalk-Board Presentations 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.
6	TLO 6.1 Differentiate between Software Quality Management and Software Quality Assurance. TLO 6.2 Apply the phases of Software Quality Assurance in software development project TLO 6.3 Apply software quality evaluation standards.	**Unit - VI Software Quality Assurance** 6.1 Software Quality Management vs. Software Quality Assurance. 6.2 Phases of Software Quality Assurance: Planning, activities, audit, and review. 6.3 Quality Evaluation standards: Six Sigma, CMMI: Levels, Process areas.	Lecture Using Chalk-Board Presentations Case Study

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 Use software tool to Write problem statement and identify scope of the project	1	*Write problem statement to define the project title with bounded scope of the project.	2	CO1
LLO 2.1 Use appropriate process model and activities related to project.	2	Select relevant process model to define activities and related tasks set	2	CO1
LLO 3.1 Apply the principles of requirement engineering.	3	*Gather application specific requirements for assimilate into RE (Requirement's engineering) model.	2	CO2
LLO 4.1 Create SRS document for the project.	4	*Prepare broad SRS (software requirement software) for the project.	2	CO2
LLO 5.1 Construct use case diagram for software models.	5	*Write use-cases and draw use-case diagram.	2	CO3
LLO 6.1 Design activity diagram for the project.	6	Draw the activity diagram to represent flow from one activity to another for software development.	2	CO3
LLO 7.1 Draw data flow diagram for the project. LLO 7.2 Create Decision tables and E-R diagram.	7	*Create DFDs (data flow diagram), Decision tables and E-R (entity-relationship) diagram.	2	CO3
LLO 8.1 Represent software project by class diagrams.	8	Draw class diagram and Sequence diagram, State Transition Diagram.	2	CO3
LLO 9.1 Prepare decision table for the project	9	* Create decision table for a project.	2	CO3
LLO 10.1 Design test cases by referring SRS document.	10	*Write test cases to validate requirements from SRS document.	2	CO3
LLO 11.1 Write test cases for Blackbox testing.	11	Prepare test cases for Black Box Testing.	2	CO3
LLO 12.1 Identify risk involved in the project LLO 12.2 Prepare RMMM Plan.	12	* Identify risks involved in the project and prepare RMMM (RMMM-Risk Management, Mitigation and Monitoring) plan.	2	CO4
LLO 13.1 Estimate size of project using function point matrix	13	* Calculate size of the project using Function point metric.	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Estimate size of project using COCOMO approach.	14	*Calculate cost of the project using COCOMO (Constructive Cost Model) / COCOMO II approach.	2	CO4
LLO 15.1 Prepare project schedule using CPM/PERT technique.	15	*Create software project scheduling charts using CPM (Critical Path Method) / PERT (Project Evaluation and Review Technique)	2	CO5
LLO 16.1 Monitor the progress of project using timeline/Gantt chart	16	Track progress of the project using Timeline charts/ Gantt charts.	2	CO5
LLO 17.1 Prepare SQA plan to ensure various quality processes.	17	Prepare SQA plan that facilitates various attributes of quality of process.	2	CO6
LLO 18.1 Prepare SQA plan to ensure quality product.	18	*Prepare SQA plan that facilitates various attributes of quality of product.	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

- Apply the principles of software engineering for Portfolio website for showcasing Skills and Work , Searchability and Online Presence , Demonstrating Growth and Progress , Career Advancement and Networking and Prepare complete technical document.
- Apply the principles of software engineering for Chatbot Application to create an intelligent chatbot to enhance customer support processes, providing efficient and personalized assistance and Develop technical document.
- Apply the principles of software engineering for Online Chat Application Project that enables users to exchange messages and communicate with each other in real-time. It allows individuals or groups to have conversations, share information, and collaborate instantly over the Internet. Online Chat Application is designed to provide a responsive and interactive experience, where messages are delivered and displayed immediately as they are sent and Prepare complete technical document.

Assignment

- Estimate Cost of software using any tool and risk involved in the library Management System
- Create DFDs, Activity Diagram, ER-Diagrams for Student Management System.
- Visit any medical shop and collect requirements from shop keeper and create SRS document

Other

- Complete the course basic of software engineering on Infosys Springboard or any MOOCs platforms.

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	Software Project Management Tools: Open source Software such as Jira.	1,2,3,4,10,11,17,18
2	Software Design tools : Projectriskmanager	12
3	Software Design tools :Open Project, Ganttproject 3.3	15,16
4	Software Design tools: Free Use Case Diagram Creator	5
5	Software Design tools: Draw.io, Decision Table Maker, Tiny tools	6,7,8,9,13,14
6	Hardware: Personal computer, processor i3 and above, RAM minimum 4 GB	All
7	Operating system: Windows 10 and above	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	Software Development Process	CO1	7	2	6	4	12
2	II	Software Requirement Engineering	CO2	9	4	6	4	14
3	III	Software Modelling and Design	CO3	9	4	4	8	16
4	IV	Software Project Cost Estimation	CO4	8	2	2	8	12
5	V	Software Project Management	CO5	4	2	2	4	8
6	VI	Software Quality Assurance	CO6	3	2	2	4	8
Grand Total				**40**	**16**	**22**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Each practical will be assesed considering 60% weightage to process, 40% weighatge to product.
- Continuous assessment based on process and product related performance indicators.
- A Continuous assessment -based term work.

Summative Assessment (Assessment of Learning)

- End Semester Examination, Lab Performance, Viva voce

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	1	2	2	2	1	-	1			
CO2	2	3	3	2	1	-	1			
CO3	2	2	3	3	-	-	1			
CO4	2	2	2	3	-	2	2			
CO5	2	3	2	3	-	3	2			
CO6	-	2	2	3	1	2	2			

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Roger S. Pressman & Bruce R. Maxim	Software Engineering: A practitioner's approach	McGraw Hill Higher Education, New Delhi, (Ninth Edition) ISBN 93-5532-504-5
2	Richard Fairly	Software Engineering Concepts	McGraw Hill Education New Delhi -2001, ISBN-13: 9780074631218
3	Deepak Jain	Software Engineering: Principles and practices	Oxford University Press, New Delhi ISBN 9780195694840
4	Srinivasan Desikan, Gopalaswamy Ramesh	Software Testing: Principles and Practices	PEARSON Publisher: Pearson India 2007, ISBN: 978-81-7758-121-8
5	Ron Patton	Software Testing	Sams Publishing; 2nd edition, 2005 ISBN: 0672327988

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.geeksforgeeks.org/software-engineering-introduction-to-software-engineering/	Software engineering tutorials from Geeksforgeeks
2	https://www.tutorialspoint.com/software_engineering/index.htm	Software Engineering Tutorials
3	https://www.sei.cmu.edu/	Software Engineering Institute
4	https://www.youtube.com/watch?v=WjwEh15M5Rw	Agile Methodology
5	https://app.diagrams.net/	Software Design -DFDs, Class Diagrams, Use Case Diagrams

SOFTWARE ENGINEERING **Course Code : 315323**

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

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

CLOUD COMPUTING **Course Code : 315325**

Programme Name/s	**: Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Computer Hardware & Maintenance/ Computer Science & Information Technology/ Computer Science**
Programme Code	**: CM/ CO/ CW/ HA/ IH/ SE**
Semester	**: Fifth**
Course Title	**: CLOUD COMPUTING**
Course Code	**: 315325**

I. RATIONALE

Cloud computing has evolved as a very important computing model. It enables information, software, and other shared resources to be provisioned over the network as services in an on-demand manner. There are many aspects of cloud computing viz cloud types, storage in cloud, security in cloud, cloud monitoring and management. This course provides implementing virtualization, creation of cloud based storage, implementing security, and managing cloud services.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain following Industry Identified Competency through various Teaching Learning Experiences: Manage Cloud based services.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Use basic Cloud based applications.
- CO2 - Explain Virtualization in Cloud Computing.
- CO3 - Maintain storage system and services in Cloud.
- CO4 - Apply Security in Cloud Computing.
- CO5 - Use various Cloud Platforms.

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	
315325	CLOUD COMPUTING	CLC	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

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.* 10 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 characteristics of Cloud computing. TLO 1.2 Compare Cloud deployment models on the given services. TLO 1.3 Explain the given service offered by identified Cloud service model. TLO 1.4 Explain components of Cloud computing architecture.	**Unit - I Fundamentals of Cloud Computing** 1.1 Definition of Cloud Computing, Characteristics of Cloud computing 1.2 Cloud Deployment Models(Introduction, advantages and disadvantages) : Public Cloud, Private Cloud, Community Cloud, Hybrid Cloud 1.3 Cloud Service Models (Function, advantages, disadvantages) : IaaS, PaaS, SaaS 1.4 Cloud cost benefits 1.5 Architectural and Infrastructural components of Cloud Computing	Lecture Using Chalk-Board Presentations Flipped Classroom
2	TLO 2.1 Explain features of Virtualization. TLO 2.2 Compare characteristics of Virtualization types. TLO 2.3 Write the steps to build a virtual machine using VMWare on the given Operating System. TLO 2.4 Differentiate Virtual Machine Migration, Consolidation and Management. TLO 2.5 Explain advantages and disadvantages of Virtualization.	**Unit - II Virtualization** 2.1 Introduction, Virtualization Reference Model, Characteristics of virtualized environment 2.2 Differentiate various types of Virtualization : Storage, Network , Desktop , Application server 2.3 Technology Examples 2.3.1 VMWare: Full Virtualization Reference Model 2.3.2 Xen: Architecture and Guest Operating System Management 2.4 Definition and Life Cycle of Virtual Machine(VM), VM Migration: Concept and Techniques, VM Consolidation: Concepts, VM Management: Concepts 2.5 Advantages and Disadvantages of Virtualization	Flipped Classroom Presentations Lecture Using Chalk-Board Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Explain Cloud storage system architecture. TLO 3.2 Write steps to design storage system for the given Cloud set-up. TLO 3.3 Compare GFS and HDFS. TLO 3.4 Describe the components of federated Cloud computing. TLO 3.5 Compare different types of Service Level Agreement (SLA). TLO 3.6 Describe the Cloud service life cycle.	**Unit - III Cloud Storage, Monitoring and Management** 3.1 Cloud Storage System Architecture 3.2 Virtualize Data Centre (VDC) Architecture, VDC Environment, Server, Storage, Networking, Desktop and Application Virtualization techniques and benefits 3.3 Cloud File Systems: Google File System (GFS) : Components, Features, Advantages and Disadvantages and Hadoop Distributed File System (HDFS) :Terminologies like Heartbeat, Balancing and Replication, Features and Limitations 3.4 Service Provider and users, An architecture of federated Cloud computing : Model and It's Explanation 3.5 Service Level Agreement (SLA) 3.5.1 SLA management: 5 Phases of SLA management like Feasibility, On-Boarding, Pre-production, Production and Termination 3.5.2 Types of SLA: Infrastructure SLA and Application SLA 3.5.3 Life cycle of SLA: 5 Phases like Contract Definition, Publishing and Discovery , Negotiation, Operationalization and De-commissioning 3.6 Cloud Service life cycle phases: Service planning, service creation, service operation and service termination	Presentations Lecture Using Chalk-Board Video Demonstrations Hands-on
4	TLO 4.1 Explain security and related risks in Cloud Computing. TLO 4.2 Explain key features of Data Security. TLO 4.3 Write steps to implement Cloud Data Security. TLO 4.4 Explain identity management and access facility of given Cloud set-up. TLO 4.5 Explain the features of Security-As-A-Cloud Service.	**Unit - IV Security in Cloud Computing** 4.1 Cloud Security Concepts: Multi-tenancy, Virtualization, Data Outsourcing and Trust Management, Metadata security 4.2 Cloud Risk: Concept, Types of Cloud Risks 4.2.1 Policy and Organizational Risks 4.2.2 Technical Risks 4.2.3 Legal Risks 4.3 Data security technologies, Data Security risks 4.4 Digital Identity and Access Management 4.5 Content level security: Pros and Cons, Features of Security-As-A-Cloud Service	Lecture Using Chalk-Board Presentations Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Explain the characteristics of the enabling technology with the IoT. TLO 5.2 Select relevant Cloud platform or application for development. TLO 5.3 Describe the features of Cloud-based smart device. TLO 5.4 Compare features of various Cloud platforms.	**Unit - V Trends in Cloud** 5.1 Cloud trends in supporting Ubiquitous Computing 5.2 Enabling Technology in the Internet of Things(RFID, Sensor Networks and ZigBee Technologies, GPS) 5.3 Innovative Applications with the Internet of Things (Ex: Health care: ECG Analysis in Cloud and it's access, CRM and ERP: Business and Consumer Application) 5.4 Benefits of Cloud Platforms : Amazon EC2 and S3, CloudStack, Intercloud, Google App Engine, Open stack, Open Nebulla	Presentations Video Demonstrations Lecture Using Chalk-Board Model Demonstration

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Configure Cloud storage.	1	* Configure Cloud using JustCloud	2	CO1
LLO 2.1 Create document for given application.	2	Use Goggle Doc to make spreadsheet and notes	2	CO1
LLO 3.1 Create virtual environment.	3	* Create Virtual Machines using VMware (Private Cloud) and delete the created VM after completion	2	CO2
LLO 4.1 Implement storage service on Cloud.	4	* Implement Storage Service on Cloud using OpenStack	2	CO3
LLO 5.1 Create and Host Web Application.	5	* Create and Host Simple Web Application on Google cloud/Any cloud platform	2	CO3
LLO 6.1 Create a File system on Cloud.	6	Create a File System using HDFS	2	CO3
LLO 7.1 Create a workspace platform for development.	7	Work in Codenvy to show Provisioning and Scaling of a website	2	CO3
LLO 8.1 Implement Identity Management and Access Management using Cloud computing infrastructure.	8	* Implement Identity Management and Access Management using OpenStack	2	CO4
LLO 9.1 Configure server for security.	9	Configure Server using CFEngine or any other open source tool	2	CO4
LLO 10.1 Design IoT based application.	10	* Design an application based on IoT using Arduino or Raspberry Pi	2	CO5
LLO 11.1 Design Cloud based application.	11	Design any automated application using RFID	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

- A suggestive list of micro-projects is given here. Similar micro-projects could be added by concerned faculty:

a) Prepare the report on case study of Amazon Cloud Services.
b) Prepare the report on case study of Google App Engine.
c) Create infrastructure as service using OpenStack.
d) Develop Personal Cloud using Raspberry Pi or any equivalent platform.

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 - Hardware: Min 8GB RAM, 512 GB HDD, Gigabit Ethernet network equipment, Software Requirement: Apache Tomcat, Java, Python, Virtualization Software, Academic version of any public cloud service(Google/AWS)	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	Fundamentals of Cloud Computing	CO1	6	4	6	0	10
2	II	Virtualization	CO2	8	4	4	8	16
3	III	Cloud Storage, Monitoring and Management	CO3	10	4	4	8	16
4	IV	Security in Cloud Computing	CO4	8	2	6	6	14
5	V	Trends in Cloud	CO5	8	0	6	8	14
Grand Total				**40**	**14**	**26**	**30**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- 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)

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

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	-	2	1	-	-	-			
CO2	2	2	2	2	1	1	1			
CO3	2	2	1	1	1	-	1			
CO4	1	2	-	2	1	1	1			
CO5	1	2	1	1	2	1	1			

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Rajkumar Buyya, James Broberg, Andrzej Goscinski	Cloud Computing, Principals and Paradigms	A John Wilwy & Sons, Inc.,Publication, ISBN: 978-0-470-88799-8
2	Sharma Rishabh	Cloud Computing	Wiley Publication, ISBN: 978-81-265-5306-8
3	Christian Vecchiola, Rajkumar Buyya, and S.Thamarai Selvi	Mastering Cloud Computing	McGraw Hill Publication, ISBN 978-1-25-902995-0
4	Singh Shailendra	Cloud Computing	Oxford University Press, ISBN: 978-0199477388
5	Arshdeep Bahga, Vijay Madisetti	Cloud Computing: A Hands-On Approach	Self published, ISBN 1494435144, 9781494435141

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.techopedia.com/definition/2/cloud-computing	Cloud computing, How it works, Components and Types of Cloud Computing, Cloud Deployment Models

CLOUD COMPUTING **Course Code : 315325**

Sr.No	Link / Portal	Description
2	https://nptel.ac.in/courses/106105167	This course will introduce various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends. This will help students and researchers to use and explore the cloud computing platforms.
3	https://www.geeksforgeeks.org/service-level-agreements-in-cloud-computing/?ref=lbp	Service level agreements in Cloud computing
4	https://www.javatpoint.com/virtualization-in-cloud-computing	Virtualization in Cloud Computing
5	https://www.coursera.org/learn/cloud-security-on-aws/supplement/AcCam/course-overview	Learn AWS cloud security essentials: challenges, AWS services, advanced techniques, network security, encryption, breach response, compliance.
6	https://www.proquest.com/openview/53e8a5ed4ebc5ff06d57ebee9cba2a72/1?pq-origsite=gscholar&cbl=5444811	Research Paper on Current Development, Challenges, and Future Trends in Cloud Computing: A Survey

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 ANALYTICS **Course Code : 315326**

Programme Name/s	**: Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Information Technology/ Computer Science & Information Technology/ Computer Science/ Electronics & Computer Engg.**
Programme Code	**: CM/ CO/ CW/ IF/ IH/ SE/ TE**
Semester	**: Fifth**
Course Title	**: DATA ANALYTICS**
Course Code	**: 315326**

I. RATIONALE

Data Analytics uses statistical and computational methods to analyze data, aiding informed decision-making. Excel dashboards effectively present vital data at a glance, enhancing user interactivity. A Data Analyst collects, cleans, and visualizes Datasets to solve problems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Perform Data Analytics in various business domains for improved decision making

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Elaborate the fundamental concepts of Data Analytics.
- CO2 - Apply appropriate statistical techniques to analyze and interpret complex Datasets.
- CO3 - Analyze numerical data by creating pivot table.
- CO4 - Represent data in terms of various types of charts.
- CO5 - Visualize the data using a Python library.

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	
315326	DATA ANALYTICS	DAN	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

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.* 10 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 importance of data analytics. TLO 1.2 Differentiate between types of data analytics. TLO 1.3 Describe the quality and quantity of data. TLO 1.4 Measures the central tendency of given dataset. TLO 1.5 Use various sampling techniques.	**Unit - I Introduction to Data Analytics** 1.1 Data Analytics: An Overview, Importance of Data Analytics 1.2 Types of Data Analytics: Descriptive Analysis, Diagnostic Analysis, Predictive Analysis, Prescriptive Analysis, Visual Analytics 1.3 Life cycle of Data Analytics, Quality and Quantity of data, Measurement 1.4 Data Types, Measure of central tendency, Measures of dispersion 1.5 Sampling Funnel, Central Limit Theorem, Confidence Interval, Sampling Variation	Presentations Lecture Using Chalk-Board Case Study
2	TLO 2.1 Create a box plot of the test scores and interpret its key components. TLO 2.2 Perform correlation and regression analysis. TLO 2.3 Use various methods to address missing values in Dataset. TLO 2.4 Apply Anova and Chi Square test. TLO 2.5 Use scatter diagrams. TLO 2.6 Test hypothesis. TLO 2.7 Explain the concept of a sampling distribution. TLO 2.8 Analyze the probability distribution.	**Unit - II Statistical Analysis** 2.1 Graphical techniques, box plot, skewness and kurtosis, Descriptive Stats 2.2 Correlation and Regression, Data Cleaning 2.3 Imputation Techniques 2.4 Anova and Chi Square 2.5 Scatter Diagram 2.6 Estimation and Hypothesis Testing 2.7 Sampling Distributions, Counting 2.8 Probability,Probability Distributions	Presentations Lecture Using 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.
3	TLO 3.1 Describe the steps for making excel dashboard. TLO 3.2 Create a pivot Table. TLO 3.3 Sort and filter the pivot tables. TLO 3.4 Create a pivot chart for different types of grouping items. TLO 3.5 Describe various formatting operations on pivot table.	**Unit - III Data Analytics with Excel** 3.1 Excel Dashboard: Tables and Data Grids, Dynamic Filters and Controls, Trend Analysis and Forecasting 3.2 Pivot Tables: Creating a Pivot Table Specifying Pivot Table Data 3.3 Changing a Pivot Tables, Calculation Filtering and Sorting a Pivot Table 3.4 Creating a Pivot Chart, Grouping Items 3.5 Updating a Pivot Table, formatting a Pivot Table using Slicers	Presentations Hands-on Demonstration
4	TLO 4.1 Create relevant chart based on requirement. TLO 4.2 Describe the process of selecting the data range. TLO 4.3 Explain the features of Chart Wizard. TLO 4.4 Explain the steps to move an embedded chart to a new position within the same worksheet. TLO 4.5 Format various components of given type of chart.	**Unit - IV Data Visualization** 4.1 Creating a Simple Chart, Charting Non-Adjacent Cells 4.2 Creating a Chart Using the Chart Wizard, Modifying Charts, Moving an Embedded Chart, Sizing an Embedded Chart 4.3 Changing the Chart Type, Changing the Way Data is Displayed, Moving the Legend 4.4 Formatting Charts, Adding Chart Items, Formatting All Text, Formatting and Aligning Numbers, Formatting the Plot Area, Formatting Data Markers 4.5 Pie Charts, Creating a Pie Chart Moving the Pie Chart to its Own Sheet Adding Data Labels, Exploding a Slice of a Pie Chart	Presentations Hands-on Demonstration
5	TLO 5.1 Describe the steps for Installing and setting up Matplotlib in Python. TLO 5.2 Create various types of plots. TLO 5.3 Customize Plots. TLO 5.4 Write steps to Export plots in different formats.	**Unit - V Data Visualization using Python** 5.1 Overview of Matplotlib and its role in data visualization, Installing and setting up Matplotlib in Python 5.2 Basic plotting with Matplotlib, Line plot, Scatter plots, Bar charts, Histograms, adding titles, labels, and legends to plots 5.3 Changing figure size and aspect ratio, Customizing axes (limits, ticks, and labels) 5.4 Exporting and Saving Visualizations: Saving plots in different formats (PNG, PDF, SVG), Adjusting the resolution and quality of saved plots, creating interactive visualizations using Matplotlib widgets	Presentations Hands-on 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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Perform Statistical Analysis in Excel.	1	*a. Calculate mean, median, and mode for a given dataset using Excel functions (AVERAGE, MEDIAN, MODE). *b. Calculate range, interquartile range (IQR), variance, and standard deviation using Excel functions (STDEV, VAR). *c. Calculate the correlation coefficient between two variables using the CORREL function	2	CO1
LLO 2.1 Construct box plot. LLO 2.2 Perform the different types of function using linear regression. LLO 2.3 Perform T-test in Excel. LLO 2.4 Calculate confidence intervals for the mean of a dataset. LLO 2.5 Apply Chi-square test for independence.	2	*a. Construct a box plot using the Insert Chart feature to identify the median, quartiles, and outliers of a dataset. *b. Perform a simple linear regression analysis *c. Conduct a t-test to compare means between two groups *d. Calculate confidence intervals *e. Conduct a Chi-square test	2	CO2
LLO 3.1 Create a table to execute the function using dashboard. LLO 3.2 Perform various operations for data cleaning.	3	*Create a Data Table a. Import a sample dataset (e.g., sales data) into Excel. b. converts the dataset into an Excel Table using the "Format as Table" feature and apply appropriate styles. c. Create a dashboard sheet that summarizes key metrics (e.g., total sales, average sales per region) using tables. *Data Cleaning a. Identify and remove duplicates from a dataset. b. Use functions like TRIM, UPPER, LOWER, and PROPER to clean text data. c. Find and replace values using the Find & Replace feature.	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Create a pivot table to analyze the data set. LLO 4.2 Sort and filter the given data set.	4	Create a Pivot Table a. A basic pivot table from a dataset b. Specify and filter data in a pivot table c. Add a calculated field to a pivot table d. Group data within a pivot table. Refresh pivot table data after making changes to the source data. Filter and sort a PivotTable a. Apply a Filter to the PivotTable b. Sort Data in the Pivot Table. c. Add slicers to the PivotTable for interactive filtering.	2	CO3
LLO 5.1 Customize your chart with titles, labels, colors, and legends as desired.	5	Create a Pivot Chart a. A basic pivot chart from a dataset b. A dynamic pivot chart that updates based on user selection c. Group date items in a pivot table to summarize data by month or year d. Group product categories in a pivot table	2	CO3
LLO 6.1 Create a simple chart to visualize the data sets.	6	*Create a Simple Chart a. A simple bar chart to visualize data sets b. A chart using non-adjacent cells to visualize data from different ranges. *Create a Chart Using the Chart Wizard a Select the chart you created and experiment with the Chart Tools options b. Modifying Charts c. Moving an Embedded Chart d. Sizing an Embedded Chart	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Change the chart type with adding data labels, axis format, and adjusting the gridlines.	7	*Change the Chart Type a. Create a basic bar chart using a dataset and change its type to a different chart b. Experiment with different data display options, such as adding data labels, changing the axis format, and adjusting the gridlines c. Experiment with position and style of the legend	2	CO4
LLO 8.1 Design a pie chart.	8	a. Create a pie chart from a dataset b. Move the pie chart to a new worksheet for better visibility c. Emphasize a specific category by exploding a slice of the pie chart d. Customize the appearance of the pie chart for better presentation	2	CO4
LLO 9.1 Generate and Save the plot in various formats.	9	* Create different types of plots.Write a Python script to save the plot in different formats: PNG, PDF, and SVG.	2	CO5
LLO 10.1 Analyze data analytics applications across various business domains.	10	Application of data analytics across various industries through case study	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)

Other

- NA

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Microsoft Office ,Office 365	1,2,3,4,5,6,7,8,9
2	Software: Editor: Python setup	10,11
3	Computer (i5 preferable), RAM minimum 8 GB onwards.	All
4	Operating system: Windows 10 onward	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 Analytics	CO1	10	4	4	8	16
2	II	Statistical Analysis	CO2	8	2	4	10	16
3	III	Data Analytics with Excel	CO3	8	2	2	8	12
4	IV	Data Visualization	CO4	8	2	4	6	12
5	V	Data Visualization using Python	CO5	6	2	4	8	14
Grand Total				**40**	**12**	**18**	**40**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous assessment based on process and Product related performance indicator.Each practical will be assessed considering 1) 60% weightage is to process 2) 40% weightage to product

Summative Assessment (Assessment of Learning)

- End Semester Examination, Lab Performance ,Viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

DATA ANALYTICS **Course Code : 315326**

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Jinjer Simon	Excel Data Analysis: Your visual blueprint for analyzing data, charts, and PivotTables	Wiley Publication Edition: 3rd ISBN: 978-0-470-59160-4
2	A. J. Smalley	Data Analysis with Excel	SAGE Publications Edition: 1st, 2007 ISBN 10: 0070139903 / ISBN 13: 9780070139909
3	Fabio Nelli	Python Data Analytics: With Pandas, NumPy, and Matplotlib	Apress pubication ISBN-13 :978-1484239124 ISBN-13978-1484247372
4	Jake VanderPlas	Python Data Science Handbook	Shroff/O'Reilly Publication ISBN-10-9355422555 ISBN-13-978-9355422552
5	Business Analytics with MindTap	Jeffrey D. Camm | James J Cochran | Michael J. Fry | Jeffrey W. Ohlmann	Cengage Learning India Pvt. Ltd. Publication Edition:4th ISBN: 9789360533533

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://spreadsheetpoint.com/excel/dashboard-in-excel/	Advance Excel
2	https://www.javatpoint.com/how-to-create-a-dashboard-in-excel	Excel Dashboard
3	https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel	Data Visualization
4	https://www.freecodecamp.org/news/introduction-to-data-vizualization-using-matplotlib/	Matplotlib in Python
5	https://archive.nptel.ac.in/courses/106/107/106107220/	Introduction to data analytics

DATA ANALYTICS **Course Code : 315326**

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