Maharashtra State Board Of Technical Education, Mumbai

Teaching and Examination Scheme for Post S.S.C. Diploma Courses

Program Name : Diploma in Artificial Intelligence and Machine Learning

Program Code : AN

Duration of Program : 6 Semesters — **With Effect From Academic Year: 2021 – 22**

Semester : Fifth — **Duration : 16 Weeks**

Pattern : Semester – Full Time — **Scheme : I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory						Practical						
								Exam Duration in Hrs.	ESE		FA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Environmental Studies	EST	22447	3	-	-	3	90 Min	70*#	28	30*	0	100	40	--	--	--	--	--	--	100
2	Operating System	OSY	22516	3	-	2	5	3	70	28	30*	0	100	40	25@	10	25	10	50	20	150
3	Client Side Scripting Language	CSS	22519	3	-	2	5	3	70	28	30*	0	100	40	25#	10	25	10	50	20	150
4	Fundamental AI & ML Algorithms	FAM	22593	3	-	2	5	3	70	28	30*	0	100	40	25@	10	25	10	50	20	150
Elective (Any One)																					
5	Advanced Database Management Systems	ADM	22521	3	-	2	5	3	70	28	30*	0	100	40	25#	10	25	10	50	20	150
	Cloud Computing for Data Science	CCD	22594																		
6	Industrial Training	ITR	22057	-	-	6	6	--	--	--	--	--	--	--	75#	30	75~	30	150	60	150
7	Capstone Project Planning	CPP	22058	-	-	2	2	--	--	--	--	--	--	--	25@	10	25~	10	50	20	50
			Total	**15**	**-**	**16**	**31**	--	**350**	--	**150**	--	**500**	--	**200**	--	**200**	--	**400**	--	**900**

Student Contact Hours Per Week: **31 Hrs.** Medium of Instruction: **English**

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Theory and practical periods of 60 minutes each. Total Marks : **900**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based Assessment

* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.

Program Name : **All Branches of Diploma in Engineering and Technology / Diploma in Artificial Intelligence and Machine Learning / Diploma in Computer Hardware & Maintenance / Diploma in Electronics and Computer Engineering / Diploma in Cloud Computing & Big Data**

Program Code : **CE/CR/CS/CH/CM/CO/IF/CW/DE/EJ/EN/EQ/ET/EX/IE/MU/EE EP/EU/IS/IC/AE/FG/ME/PG/PT/DC/TX/TC/AN/HA/TE/BD**

Semester : **Fifth**

Course Title : **Capstone Project – Planning**

Course Code : **22058**

1. RATIONALE

According to the requirement of National Board of Accreditation (NBA), 'learning to learn' is an important Graduate Attribute (GA No.11). It is required to develop this skill in the students so that they continue to acquire on their own new knowledge and skills from different 'on the job experiences' during their career in industry. An educational 'project' just does that and may be defined as ***'a purposeful student activity, planned, designed and performed by a student or group of students to solve/ complete the identified problem/task, which require students to integrate the various skills acquired over a period to accomplish higher level cognitive and affective domain outcomes and sometimes the psychomotor domain outcomes as well'***. Projects mainly serve this purpose of developing learning-to-learn skills with an aim to develop the following attributes in the students:

a) Initiative, confidence and ability to tackle new problems
b) Spirit of enquiry
c) Creativity and innovativeness
d) Planning and decision making skills
e) Ability to work in a team and to lead a team
f) Ability of self directed learning which is required for lifelong learning
g) Persistence (habit of not giving up quickly and trying different solutions in case of momentary failures, till success is achieved)
h) Resourcefulness
i) Habit of keeping proper records of events and to present a formal comprehensive report of their work.

2. COMPETENCY

The course should be taught and implemented with the aim to develop the required course outcomes (COs) so that students will acquire following competency needed by the industry:

- **Plan innovative/creative solutions independently and/or collaboratively to integrate various competencies acquired during the semesters to solve/complete the identified problems/task/shortcomings faced by industry/user related to the concerned occupation.**

3. COURSE OUTCOMES (COs)

The following could be some of the major course outcomes depending upon the nature of the projects undertaken. However, in case of some projects few of the following course outcomes may not be applicable.

a) Write the problem/task specification in existing systems related to the occupation.

b) Select, collect and use required information/knowledge to solve the problem/complete the task.
c) Logically choose relevant possible solution(s).
d) Consider the ethical issues related to the project (if there are any).
e) Assess the impact of the project on society (if there is any).
f) Prepare 'project proposals' with action plan and time duration scientifically before beginning of project.
g) Communicate effectively and confidently as a member and leader of team.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
-	-	2	2	--	--	--	--	--	--	--	25@	10	25	10	50	20

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment

5. Capstones Project

One of the dictionary meaning is the 'crown' or the stone placed on top of the building structure like 'kalash on top of Temples and Mosques' or 'Cross on top of churches'. Capstone projects are culminating experiences in which students synthesize the competencies acquired over whole programme. In some cases they also integrate cross-disciplinary knowledge. Thus Capstone projects prepare students for entry into a career and can be described as a 'rite of passage' or 'minimal threshold' through which participants change their status from student to graduate. A capstone project therefore should serve as a synthesis — reflection and integration— to bridge the real-world preparatory experience to real life. Thus capstone project should have emphasis on integration, experiential learning, and real-world problem solving and hence these projects are very important for students. To develop the highly essential industry oriented skills and competencies in the students, the capstone projects are offered in the last two semesters to serve for following purposes:

a) Integrate the competencies acquired by the students in the previous and current semesters.
b) Provide opportunities for interdisciplinary work in tackling problems likely to be faced by them in industry which are exciting and challenging.

6. Capstone Project Planning

Students are supposed to find out a suitable project and prepare a detailed plan in fifth semester so that it can be executed smoothly in sixth semester. The main characteristic of any project whether small or big is that it requires simultaneous application of various types of skills in the different domains of learning. Moreover, project normally do not have a predefined single solution, in other words for the same problem different students may come up with different but acceptable solutions. Further, in the process of arriving at a particular solution, the student must be required to make a number of decisions after scrutiny of the information s/he has accumulated from experiments, analysis, survey and other sources.

The projects will have a detailed project proposal, which must be executed or implemented within the time allocated, simultaneously maintaining a logbook periodically monitored by the teacher. A detailed project report is to be prepared as project progresses, which has to be submitted after the project is over. For self assessment and reflection students have to also prepare a portfolio of learning.

During the guidance and supervision of the project work, teachers' should ensure that students acquire following ***learning outcomes*** (depending upon the nature of the project work some of these learning outcomes may not be applicable):

a) Show the attitude of enquiry.
b) Identify the problems in the area related to their programme.
c) Identify the information suggesting the cause of the problem and possible solutions.
d) Assess the feasibility of different solutions and the financial implications.
e) Collect relevant data from different sources (books/internet/market/suppliers/experts etc. through surveys/interviews).
f) Prepare required drawings and detailed plan for execution of the work.
g) Work persistently and participate effectively in group work to achieve the targets.
h) Work independently for the individual responsibility undertaken.
i) Ask for help from others including guide, when required.
j) Prepare portfolio to reflect *(chintan-manan)* on experiences during project work.
k) Prepare seminar presentations to present findings/features of the project.
l) Confidently answer the questions asked about the project.
m) Acknowledge the help rendered by others in success of the project.

If students are able to acquire these *learning outcomes*, then they would be able to acquire the COs as discussed in section 3.

7. Scopes of Projects

Scope of the project work should be decided based on following criteria:

a) Relation to diploma programme curriculum: When students intend to select topics for the project work they need to choose a project which relates well to their curriculum (It may be beyond curriculum, but it should relate to it) and requires implementation of theories already learnt and skills already possessed by them from the previous semesters.

b) Abilities possessed by the group of students: Projects should be chosen so that it can be completed mainly using students' problem solving capabilities and depth of learning. It is natural that highly motivated students or high achievers may come out with projects which are more complex and challenging. Teachers should guide students to choose challenging projects according to the students' ability.

c) Resources Available: Students and Guides should keep in mind the availability of resources while deciding the topic and the scope of the project. Some of the important resources which need consideration are:

i. Time available
ii. Raw Material/Components required
iii. Manufacturing/Fabrication equipment and tools required
iv. Testing/Measuring equipment and instruments required
v. Access to Journals (Library/Digital)
vi. Expertise for theoretical guidance (available in polytechnic, nearby institutes or nearby industries)
vii. Expertise and technology required for fabrication (if required)
viii. Software required.

An important aspect to be considered is to decide who will choose a project. The best practice is that teacher should guide students about the above factors to be considered for choosing the project and based on these factors students should do the ground work and identify the possible projects and teachers should work as only facilitator and Guide in final selection of the project title and its scope.

d) Suggested Type of Capstone Projects

In general, the projects that the students can take up could be of the following types;

i. Feasibility studies.

ii. Design projects
iii. Market surveys about raw material, components or finished products.
iv. Prototype (design, make, test and evaluate).
v. Advanced experimental work requiring the development of existing equipment to be used and developed.
vi. Field works: This could include surveys, using equipment, charting data and information from visual observation.
vii. Comparative Studies: Theoretical study of two systems/mechanisms/ processes in detail and comparing them on the basis of cost/energy conservation/impact on environment/technology used etc.
viii. Application of Emerging technology: Theoretical study of some emerging technology and feasibility of its application in some real life situation in detail.
ix. Fabrication of some equipment/machine etc.
x. Construction of some structure.
xi. Development of software or use of software for solving some broad-based problem.

8. GUIDELINES FOR UNDERTAKING A PROJECT

The selection of the *Capstone Project title* must have emphasis to the Elective courses/ Elective Group taken for the study and exam for 5th and 6th semester. The students will then work on the identified problem/task through a rigorous process of understanding and analyzing the problem, conducting a literature search, deriving, discussing (monitored by the guide every fortnight) and designing the ***Semester V 'Project Proposal'*** with the following ***sub-titles***:

a) Rationale (one page)
b) Introduction
c) Literature Survey
d) Problem Definition
e) Proposed Methodology of solving Identified problem
f) In-case some prototype has to be fabricated then its tentative design and procedure for making it should be part of the proposal.
g) Resources and consumables required.
h) Action Plan (sequential list of activities with probable dates of completion)

As soon as the 'Project Proposal' is approved by the teacher, the student will begin to maintain a dated ***'Project Logbook'*** for the whole semester. This is a sort of a 'weekly diary' indicating all the activities conducted by the student every week in the semester to complete the project. This *'project logbook'* should be got signed by the teacher at regular intervals for progressive assessment to match the project proposal. If this is maintained sincerely and truthfully by the student, it will be very helpful in compiling the 'Project Report' at the end of the semester by him/her.

9. PORTFOLIO FOR SELF-DIRECTED LEARNING

To ensure that students acquire these outcomes, students should also be guided to prepare a **'Portfolio',** so that they may reflect on their weaknesses/mistakes and learn from them. ***Students should also be encouraged to discuss with their guide and record not only technical problems but also problems related to group work, planning, execution, leadership in the team etc., so that students can also identify their weaknesses in affective domain and take remedial actions to overcome the same.*** If they wish, the students can also show their portfolio to their teachers (whom they trust) for obtaining teachers' comments on their reflection for pointing out their mistakes so that they can improve their performance.

'Portfolio' is the record of the reflection (thinking or *chintan-manan*) on experiences to which students undergo during the different stages of the project. In a portfolio, students record their critical experiences and reflect (think or do *chintan-manan*) on them in writing.

This process of reflecting on the experiences make them learn from their mistakes and build on their strengths. To help students in reflection, a Portfolio format with reflective prompts (simple thought provoking questions) for different stages of the project is given as annexure B.

12.1 Purposes of Portfolio Preparation

Reflection by self is important since group work is so complex that it is difficult for teachers to appreciate the real problems amongst the students. In a portfolio, prompts (simple thought provoking questions) are given to trigger reflection on different aspects of project work. Prompts help the students to ask questions from themselves regarding different aspects of the project work and interpersonal relationships. Process of answering these questions forces students to think about behavioral problems and possible remedies/solution to deal with those problems. Portfolio preparation therefore helps in reflection on building the strengths and elimination of the weaknesses of the students pertaining to following qualities which the industry also need.

a) Plan properly for execution of given work.
b) Take appropriate decisions.
c) Arrange resources.
d) Work as member and leader of team.
e) Communicate properly.
f) Resolve the conflicts.
g) Manage the time well.
h) Have concern for ethical, societal and environmental issues.
i) Learn-to-learn from experiences.

It may be seen that these qualities are not directly related with the theoretical subject knowledge and can be developed only through real life experiences. Project work is one such type of experience where opportunity is available to develop all these qualities.

However, even during project work, emphasis of most of the students and teachers remains on development of the technical knowledge and skills while development of above qualities is neglected. Students can develop these qualities if they reflect (do thinking or *Chintan-Manan*) on their experiences from the point of view of these qualities and find out their own weaknesses and strengths. Because if somebody wants to improve his/her abilities then first step for that person is to have self awareness about his/her weaknesses and strengths.

Though portfolio preparation requires considerable time, it is essential, if we want to learn from the experiences and develop these qualities. Writing down reflections helps in better reflection as it is well known that when a person starts writing something he/she becomes more cautious about his/her view and evaluate those views before writing. Thus process of writing improves the quality of reflection or thinking. Moreover, if reflections on different stages of work are written down, over a period of time a large amount of reflection can be generated, and if this reflection is looked back, it may help in identifying some pattern of behaviour in individual which may be improved or rectified latter on as per requirement.

12.2 Guidelines for Portfolio Preparation and assessment

The main purpose of portfolio preparation is learning based on self-assessment and ***portfolio is not to be used for assessment in traditional sense.***

a) Each student has to prepare his/her portfolio separately. However, he/she can discuss with the group members about certain issues on which he/she wants to write in the portfolio.
b) For fifth semester and sixth semester, there will be only one portfolio but it will have two separate parts, first part for project planning (having two sections A and B) second part for project execution. (having two sections C and D)

c) Whatever is written inside the ***portfolio is never to be used for assessment***, because if teachers start giving marks based on whatever is written in the portfolio, then students would hesitate in true self-assessment and would not openly describe their own mistakes or shortcomings.

d) Some marks are allocated for portfolio, these marks are to be given based on how sincerely portfolio has been prepared and not based on what strengths and weaknesses of the students are mentioned in the portfolio.

e) Portfolio has to be returned back to the students after assessing it (assessment is only to see that whether portfolio is completed properly or not) by teachers. Because student is the real owner of the portfolio.

f) Students mainly learn during portfolio preparation, but they can further learn if they read it after a gap. And hence they are supposed to keep the portfolios with them even after completion of the diploma because it is record of their own experiences (it is like diary some people write about their personal experiences), because they can read it again after some time and can revise their learning (about their own qualities)

Even after completion of Diploma programme, students can continue to prepare portfolio related to different experiences in their professional and personal life and by refereeing back to old portfolios after a gap of some years, they can learn that how their personality has evolved over the years. They can also see a pattern of behaviour in their own personality which may be source of their weaknesses or strengths and they can take remedial measures based on this study of their portfolios.

Note

Since some sections of the portfolio are related with interpersonal relationships and student may find it difficult to write these experiences in English. Language should not be the barrier in reflection and hence students should be allowed to prepare the portfolio in their preferred language such as *Marathi* or *Hindi if they find it difficult to write in English.*

The amount and type of mistakes identified by students would not affect the marks received by the students. The total 7 Marks allocated for portfolio (4 marks for PA and 3 for ESE) are only for proper completion of the portfolio.

10. PROJECT REPORT

At the end of fifth Semester, the student will prepare a Semester V 'Project Report' with the following sub-titles:

- Certificate (in the Format given in this document as annexure A)
- Acknowledgements
- Abstract (in one paragraph not more than 150 words)
- Content Page
- Chapter-1 Introduction and background of the Industry or User based Problem
- Chapter-2 Literature Survey for Problem Identification and Specification,
- Chapter-3 Proposed Detailed Methodology of solving the identified problem with action plan
- References and Bibliography

Note: The report should contain relevant diagrams and figures, charts.

11. ASSESSMENT OF CAPSTONE PROJECT – PLANNING

Like other courses, assessment of Project work also has two components, first is progressive assessment, while another is end of the term assessment. The mentor faculty will undertake the progressive assessment to develop the COs in the students. They can give oral informal feedback about their performance and their interpersonal behaviour while guiding them on their project work every week. The following characteristics/ qualities informally or formally

should be considered during different phases of the project work which will be assessed thrice as discussed in sub-section.

(A) Initial Phase

i. **Definition of the Problem**
   a) Accuracy or specificity
   b) Appropriateness with reference to desired course outcomes.

ii. **Methodology of Conduction the Project**
   a) Appropriateness
   b) Flexibility
   c) Clarity

iii. **General Behaviour**
   a) Initiative
   b) Resourcefulness
   c) Reasoning ability
   d) Imagination/creativity
   e) Self-reliance

(B) Intermediate Phase

i. **Performance of Student**
   a) Ability to follow correct procedure
   b) Manipulative skills
   c) Ability to collect relevant information
   d) Ability to observe, record & interpret
   e) Ingenuity in the use of material and equipment
   f) Target achievement

ii. **General Behaviour**
   a) Persistence
   b) Interest
   c) Commitment
   d) Confidence
   e) Problem solving ability
   f) Decision making ability
   g) Initiative to act
   h) Team spirit.
   i) Sharing of material etc.
   j) Participation in discussion
   k) Completion of individual responsibilities

(C) Final Phase

i. **Quality of Product**
   a) Dimensions
   b) Shape
   c) Tolerance limits
   d) Cost effectiveness
   e) Marketability
   f) Modernity

ii. **Quality of Report**
   a) Clarity in presentation and organization
   b) Styles and language
   c) Quality of diagrams, drawings and graphs
   d) Accuracy of conclusion drawn
   e) Citing of cross references

f) Suggestion for further research/project work

iii. **Quality of presentation**

a) Understanding of concepts, design, methodology, results, implications etc
b) Communication skills
c) Ability to draw conclusions and generalization

12. PROGRESSIVE ASSESSMENT (PA) GUIDELINES

15 Marks are allocated for the formal progressive assessment. However, following points need consideration during the three times of formal progressive assessment of the students at the end of 4th, 12th and 14th week.

a) ***Fortnightly monitoring*** by the mentoring teachers is necessary and marks given progressively (even the gradual chapter preparation) so that that students will not copy earlier reports or get things done or reports from the market. The ***students should not be awarded marks*** if they have not done on their own.
b) For progressive assessment at the end of 14th week, students should be asked to give the power point presentation before group of teachers and junior students (so that junior students may also get awareness about the capstone project work they have to carry out in future).
c) Although marks for *portfolio preparation* is to be given at the end of 14th week, students should be asked to bring their partly prepared portfolio (relevant sections prepared) also during their assessment at the end of 4th week and 12th week.
d) Marks for portfolio preparation should be based only on proper preparation of portfolio by writing answers to most of the prompts (self-questions to students) in the portfolio. These marks should not be based on the mistakes indicated by students in their working (while answering the prompts) and corrective actions taken by them.
e) The students would be awarded marks for their efforts (In some cases it may happen that due to some reasons such as unavailability of some material or component or some other resources, students may not be able to complete the project, but they have tried their best, in such cases students would be given appropriate marks if they have done enough efforts.)
f) ***Originality of the report*** (written in own words) would be given more importance rather than use of glossy paper or multi-colour printing.

12.1 Progressive Assessment (PA) Criteria

Allocation Criteria of the ***25 marks*** are for the Progressive Assessment (PA).

S. No.	Criteria	Marks
	First Progressive Assessment at the end of 4th week	
1	**Problem Identification/Project Title** (Innovation /Utility of the Project for industry/ User/Academia) marks to be also given based on (i) Accuracy or specificity of the scope and (ii) Appropriateness of the work with reference to desired course outcomes.	02
2	**Industrial Survey and Literature Review**: marks to be given based on extent/volume and quality of the survey of Industry / Society / Institutes/Literature/Internet for Problem Identification and possible solutions	02
3	**General Behaviour**: initiative, resourcefulness, reasoning ability, imagination/creativity, self-reliance to be assessed **Note:** Oral feedback on general behaviour may also be given whenever relevant/ required during day to day guidance and supervision. **Only written feed-back/suggestions**	**00**
	Second Progressive Assessment at the end of 12th week	

S. No.	Criteria	Marks
4	**Project Proposal**: Marks to be given also based on appropriateness, flexibility, detail and clarity in methods/planning. (In case of working models, detailed design and planning of fabrication/assembly of the prototype has to be also assessed). This proposal should include whole project including work to be done in sixth semester	**03**
5	**Execution of Plan in fifth semester** (Since project is to be fully completed in sixth semester, the part of the project which is planned to be completed in fifth semester is only to be evaluated: marks to be also given based on ability to collect relevant information, ability to follow correct procedure, manipulative skills, ability to observe, record & interpret, ingenuity in the use of material and equipment, target achievement) In case of working models, quality of workman ship (including accuracy in dimensions, shape, tolerance limits), appropriateness of raw materials/components/ technology being used, functioning of the prototype, cost effectiveness, marketability, modernity etc. has to be also assessed.	02
6	**Log book** (for work done in fifth semester, detailed and regular entry would be basis of marks)	02
7	**General Behaviour** (persistence, interest, confidence, problem solving ability, decision making ability, initiative to act, team spirit, sharing of material etc., participation in discussions, completion of individual responsibilities, leadership) **Note:** Oral feedback on general behaviour should also be given whenever relevant/ required during day to day guidance and supervision. **Only written feed-back./suggestions**	00
	Third Progressive Assessment at the end of 14th week	
8	**Portfolio for Self learning and reflection** (marks based on amount of reflection and completion of the portfolio for work done in fifth semester)	**04**
9	**Final Report writing including documentation**. (marks based on: clarity in presentation and organization; styles and language; quality of diagrams, drawings and graphs; accuracy of conclusion drawn; citing of cross references; suggestion for further research/project work) Report has to be prepared for work done in fifth semester and planning for sixth semester work.	**06**
10	**Presentation** (presentation skills including communication skills to be assessed by observing quality of presentations and asking questions during presentation and viva/voce) Report has to be prepared for work done in fifth semester and plan for sixth semester.	**02**
11	**Defence** (ability to defend the methods/materials used and technical knowledge, and involvement of individual to be assessed by asking questions during presentation and viva/voce)	**02**
	Total	**25**

13. END-SEMESTER-EXAMINATION (ESE) ASSESSENT GUIDELINES

The ***remaining 25 marks*** are for the end-semester-examination (ESE). And marks would be given according to following criteria. Moreover, the suggested evaluation scheme can be changed slightly by the external faculty according to nature of problem / project following University guidelines..

a) For each project, the one or two students from the concerned group of students should be asked to present the power point presentation before the external and internal (for about 10 minutes) and then external should ask the questions from each member of the group separately to ascertain the contribution made by each student.

b) The students would be awarded marks for their efforts (In some cases it may happen that due to some reasons such as unavailability of some material or component or some other resources, students may not be able to complete the project, but they have tried their best, in such cases students would be given appropriate marks commensurate with their efforts.)

c) The students would not be awarded marks if they have completed the project by getting done the work from market or some professionals (taking help and guidance is different as compared to getting the work or maximum part of the work completed from others on payment basis).

d) Originality of the report (written in own words, even if there are grammatical and spelling mistakes) would be given more importance rather than quality of printing and use of glossy paper (and preparing report by copy pasting from other reports).

Note: It is very common that people are not able to complete the project in time despite best of their efforts. (Please recall that how many times people are able to complete in time, personal projects such as building own house or professional projects such as developing the lab in the institute). So if students have put in enough genuine efforts but could not complete the project in time then we should consider it sympathetically and they should be given marks based on their efforts and they should get more marks as compared to students who have got their projects completed by taking major help from others/market.

13.1 End-Semester-Examination (ESE) Assessment Criteria.

Allocation Criteria of the ***25 marks*** are for the end-semester-examination (ESE)

S. No.	Description	Marks
1	**Problem Identification/Project Title** (innovation /utility of the project for industry/ user/academia) marks to be also given based on (i) accuracy or specificity of the scope and (ii) appropriateness of the work with reference to desired course outcomes.	**02**
2	**Industrial Survey and Literature Review** (marks to be given based on extent/volume and quality of the survey of industry / society / institutes/literature/internet for problem identification and possible solutions)	**02**
3	**Project Proposal**: Marks to be given also based on appropriateness, flexibility, detail and clarity in methods/planning. (In case of working models, detailed design and planning of fabrication/assembly of the prototype has to be also assessed). This proposal should include whole project including work to be done in sixth semester.	**02**
4	**Execution of Plan in fifth semester** (Since project is to be fully completed in sixth semester, the part of the project which is planned to be completed in fifth semester is only to be evaluated: marks to be also given based on ability to collect relevant information, ability to follow correct procedure, manipulative skills, ability to observe, record & interpret, ingenuity in the use of material and equipment, target achievement) In case of working models, quality of workman ship (including accuracy in dimensions, shape, tolerance limits), appropriateness of raw materials/components/ technology being used, functioning of the prototype, cost effectiveness, marketability, modernity etc has to be also assessed.	**02**
5	**Log book** (for work during fifth semester, marks to be given based on detailed and regular entry	**03**

S. No.	Description	Marks
6	**Portfolio for Self learning and reflection** (for work during fifth semester) Marks based on amount of reflection and completion of portfolio.	**03**
7	**Project Report including Documentation** (for work during fifth semester and planning for sixth semester) (marks based on: clarity in presentation and organization; styles and language; quality of diagrams, drawings and graphs; accuracy of conclusion drawn; citing of cross references; suggestion for further research/project work)	**04**
8	**Presentation** (presentation skills including communication skills to be assessed by observing the quality of presentations and asking questions during presentation and viva/voce) Presentation should be based on work done in fifth semester and planning for sixth semester.	**03**
9	**Defence** (ability to defend the methods/materials used and technical knowledge, and involvement of individual to be assessed by asking questions during presentation and viva/voce)	**04**
	Total	**25**

14. SPECIAL TEACHING STRETAGIES (If any)

a) Teacher's should not spoon feed the students and let them try on their own at different stages of the project work and even first let them strive hard and only when efforts of students have failed, then teacher should guide them. Guidance should be in initially in the form of clues or hints rather than complete explanation, detailed explanation should be given only when students are not able to work based on clues/hints. The role of teacher should be limited to guide and facilitator

b) Teachers should guide students in selecting a topic which is relevant and challenging (but within capacity) for students according to their abilities.

c) Teachers should ensure that students prepare the project plan in as much detail as possible, since this way only they would learn the importance of planning and how to do the detail planning. Teachers should allow students to proceed ahead only when they have detailed plan with them.

d) Teachers should motivate students to maintain log book and prepare portfolio. They should explain benefits of these activities to students and also train them in these activities, because most of them may be doing this first time.

e) Teachers should also encourage students to openly discuss their weaknesses and shortcomings in portfolio and teachers should develop confidence in students that admitting mistakes and weaknesses helps in improving them and their marks would not be affected by revealing their mistakes. Marks related to portfolio are awarded based only on the sincerity with which it is prepared and not based on strengths and weaknesses of students.

f) Teachers should continuously discuss with students about working of group and progress in the project and from this discussion should identify their personal qualities (both strengths and weaknesses) and suggest to them ways for improving those qualities.

g) Internal as well as external examiners should reward students for original work and efforts of students even if they are not fully successful or not able to complete the project in comparison to those students who have taken paid help from others to complete their project.

Annexure A

CERTIFICATE

This is to certify that Mr./Ms.....

From .....College having Enrolment No: .....

has completed ***Report on the Problem Definition/ Semester V Project Report/ Final Project Report*** having title .....

individually/ in a group consisting of..... persons under the guidance of the Faculty Guide.

.....
The mentor from the industry for the project
Name: .....
Telephone:.....

Annexure B

Portfolio for Self Directed Learning for Major Project Work

Name of Student:.....

Semester:.....Programme/Branch:.....

Roll Number:.....

Title of the Project:.....

Name and Designation of Project Guide:.....

Name of Polytechnic:.....

Part A: Selecting the Project and Team (Answers to the following questions to be included in 'Portfolio' as Reflection related to formation of group and finalization of project topic).

Note: This section has to be prepared just after the finalization of the Project topic and formation of the Project Team .

1. How many alternatives we thought before finalizing the project topic?
2. Did we consider all the technical fields related to branch of our diploma programme?
3. Why we found present project topic as most appropriate?
4. Whether all the group members agreed on the present project topic? If not? What were the reasons of their disagreements?
5. Whether the procedure followed in assessing alternatives and finalizing the project topic was correct? If not, discuss the reasons.
6. What were the limitations in other alternatives of project topic?
7. How we formed our team?
8. Whether we faced any problem in forming the team? If yes, then what was the problem and how was it resolved?

9. Am I the leader of our project team? If yes, then why was I chosen? If not, why I could not become the project team leader?
10. Do I feel that present team leader is the best choice available in the group? If yes, then why? If not, then why?
11. According to me who should be the leader of the team and why?
12. Can we achieve the targets set in the project work within the time and cost limits?
13. What are my significant good/ bad sharable experiences while working with my team which provoked me to think? What I learned from these experiences?
14. Any other reflection which I would like to write about formation of team and finalization of project title, if any?

Part B: Reflection related to project planning (Answers to the following questions to be included in 'Portfolio' as reflection on planning)

Note: This section has to be prepared just after the finalization of the 'Project Proposal'.

1. Which activities are having maximum risk and uncertainty in our project plan?
2. What are most important activities in our project plan?
3. Is work distribution is equal for all project group members? If not? What are the reasons? How we can improve work distribution?
4. Is it possible to complete the project in given time? If not what are the reasons for it? How can we ensure that project is completed within time.
5. What extra precaution and care should be taken in executing the activities of high risk and uncertainty? If possible, how such risks and uncertainties can be reduced?
6. Can we reduce the total cost associated with the project? If yes, then describe the ways?
7. For which activities of our project plan, arrangement of resources is not easy and convenient?
8. Did we make enough provisions of extra time/expenditure etc. to carry out such activities?
9. Did we make enough provisions for time delays in our project activity? In which activities there are more chances of delay?
10. In our project schedule, which are the days of more expenditure? What provisions we have made for availability and management of cash?
11. Any other reflection which I would like to write about project planning?

Teacher Evaluation Sheet (ESE)
for
Capstone Project Planning

Name of Student: .....

Name of Programme..... **Semester:** .....

Course Title and Code:.....

Title of the Capstone Project: .....

A. POs addressed by the Capstone Project (Mention only those predominant POs)

a) .....
b) .....
c) .....
d) .....

B. COs addressed by the Capstone Project (Mention only those predominant POs)

a) .....
b) .....
c) .....
d) .....

C. OTHER LEARNING OUTCOMES ACHIEVED THROUGH THIS PROJECT

a) **Unit Outcomes (Cognitive Domain)**

i. .....
ii. .....
iii. .....
iv. .....

b) **Practical Outcomes (in Psychomotor Domain)**

i. .....
ii. .....
iii. .....
.....
iv. .....
.....

c) **Affective Domain Outcomes**

i. .....
ii. .....
iii. .....
iv. .....

D. SUGGESTED RUBRIC FOR ASSESSMENT OF CAPSTONE PROJECT

(please tick below the appropriate rating i.e. poor, average etc., for each characteristic to be assessed and give marks in the respective cell according to performance of student)

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent	Max. Marks	marks obtained
First Progressive Assessment (at the end of 4th week)							

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent	Max. Marks	marks obtained
1	**Problem/Task Identification (Project Title)**	Relate to very few POs Scope of Problem not clear at all	i. Related to some POs ii. Scope of Problem/Task vague	i. Take care of at-least Three POs ii. Scope of Problem/task not very specific	i. Take care of more than three POs ii. Scope of problem/task very clear	02	
2	**Literature Survey /Industrial Survey**	Not more than ten sources (primary and secondary), very old reference	At-least 10 relevant sources, at least 5 latest	At –least 15 relevant sources, most latest	About 20 relevant sources, most latest	**02**	
Second Progressive Assessment (at the end of 12th week)							
3	**Project proposal**	Methods are not appropriate, All steps not mentioned, Design of prototype not started (if applicable).	Appropriate plan but not in much detail. Plan B for critical activities not mentioned. Time line is not developed. Design of Prototype is not complete. (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, but clarity is not there in methods, time line is given but not appropriate. Design of prototype is not detailed (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, clarity in methods with time line, Detailed design of prototype (if applicable)	**02**	
4	**Execution of Plan in fifth semester (please write by hand about students performance in appropriate column)**					**02**	
5	**Log Book**	Entries for most weeks are missing. There is no proper sequence and details are not correct.	Entries for some weeks are missing, details are not appropriate, not signed regularly by the guide.	Entries were made every week but are not in detail. Signed and approved by guide every week	Entries were made every week in detail, signed and approved by guide every week	**03**	
Third progressive Assessment at the end of 14th week							
6	Portfolio Preparation	Answer to only few of the 'questions from self' (prompts)	Answer to only about 50% of the 'questions from self'	Answer to most of the 'questions from self' (prompts) written. Some	Answer to nearly all the 'questions from self' (prompts) written in detail	**03**	

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent	Max. Marks	marks obtained
		written. Answers are not in much detail	(prompts) written. Answers are not in much detail	answers are not in much detail			
7	**Final Report Preparation**	Very short, poor quality sketches, Details about methods, material, precaution and conclusions omitted, some details are wrong Nearly sufficient and correct details about methods, material, precautions and conclusion. but clarity is not there in presentation, not enough graphic description.	Detailed, correct and clear description of methods, materials, precautions and	Conclusions. Sufficient Graphic Description.	Very detailed, correct, clear description of methods, materials, precautions and conclusions. Enough tables, charts and sketches	**04**	
8	**Presentation**	Major information is not included, information is not well organized .	Includes major information but not well organized and not presented well	Includes major information and well organized but not presented well	Well organized, includes major information ,well presented	**03**	
9	**Defense**	Could not reply to considerable number of question.	Replied to considerable number of questions but not very properly	Replied properly to considerable number of question.	Replied to most of the questions properly	**04**	
					Total marks	**25**	

Any Other Comment:

.....

.....

Name and designation of the Faculty Member.....**Signature**.....

.....

Program Name	**: Diploma in Civil Engineering/ Computer Engineering / Information Technology /Automobile Engineering/ Fashion & Clothing Technology / Electrical Engineering Group / Electronics Engineering Group / Diploma in Artificial Intelligence and Machine Learning / Diploma in Computer Hardware & Maintenance / Diploma in Electronics and Computer Engineering**
Program Code	**: CE/CR/CS/CO/CM/CW/IF/AE/DC/EE/EP/EU/DE/EJ/ET/EN/ EX/EQ/IE/IS/IC/AN/HA/TE**
Semester	**: Fifth**
Course Title	**: Environmental Studies**
Course Code	**: 22447**

1. RATIONALE

The world today is facing the biggest challenge of survival. Degradation of ecosystem, depletion of natural resources, increasing levels of pollution pose major threat to the survival of mankind. The need of the hour, therefore, is to concentrate on the area of environmental aspects, which shall provide an insight into various environment related issues. Environmental studies are an interdisciplinary academic field that integrates physical, chemical and biological sciences, with the study of the environment. It provides an integrated, quantitative, and interdisciplinary approach to the study of environmental system & gives an insight into solutions of environmental problems.

2. COMPETENCY

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

- **Diagnose and manage environment related issues**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Develop Public awareness about environment
b. Select alternative energy resources for Engineering Practice
c. Conserve Ecosystem and Biodiversity
d. Apply techniques to reduce Environmental Pollution
e. Manage social issues and Environmental Ethics as lifelong learning

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--		--	--

*(#) **Online Theory Examination.***

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

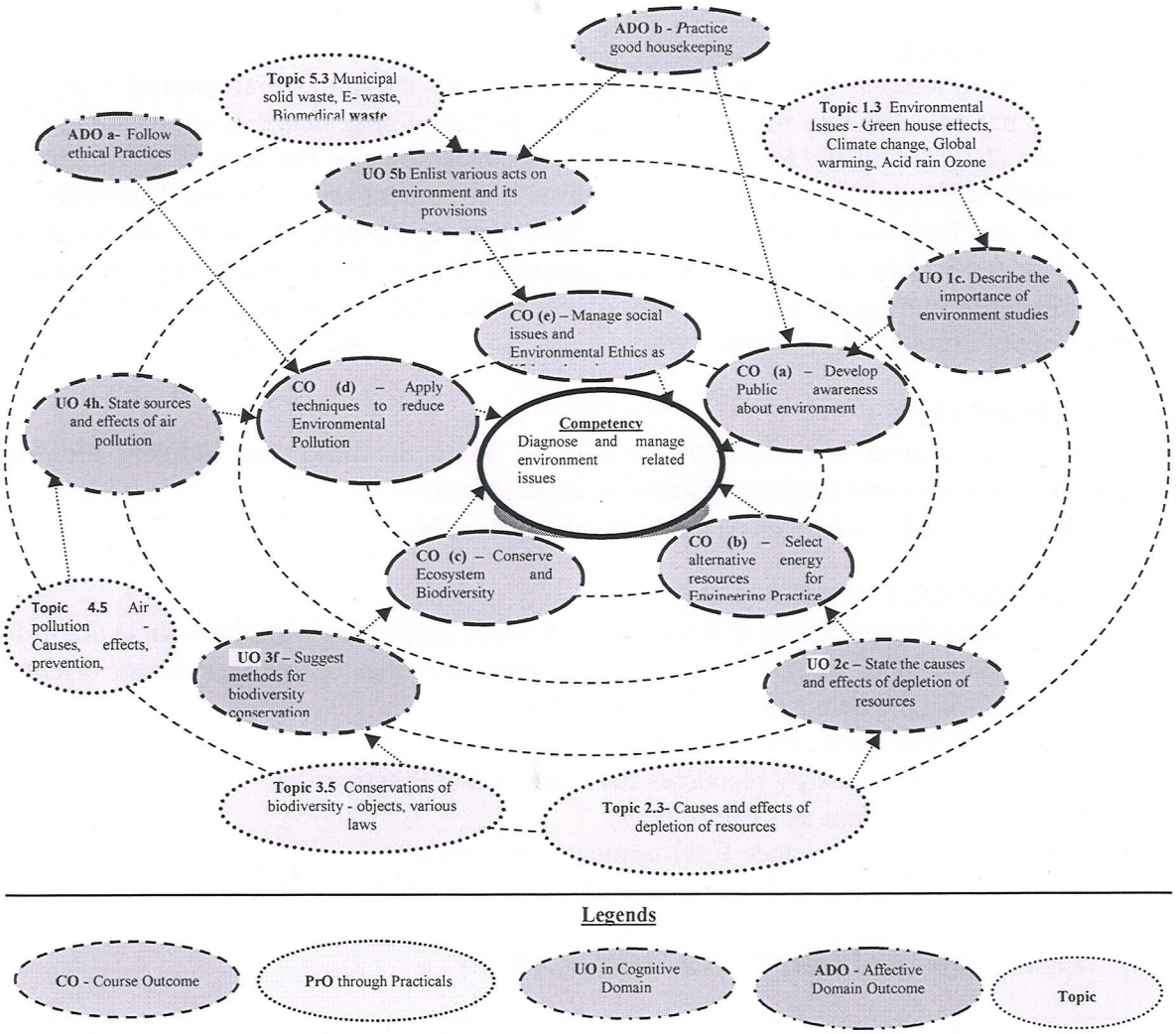


Figure 1 - Course Map

6. SUGGESTED EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	NIL		
	Total		

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	NIL	
Total		

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Demonstrate working as a leader/a team member.
e. Maintain tools and equipment.
f. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	NIL	-

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Environment	1a. Discuss the scope of Environment. 1b. Describe various types of environment 1c. Describe the importance of environment studies. 1d. Discuss about the need of public awareness about environment. 1e. Describe various environmental issues.	1.1 Definitions, need of environmental studies. 1.2 Segments of environment- Atmosphere, Hydrosphere Lithosphere, Biosphere. 1.3 Environmental Issues - Green house effects, Climate change, Global warming, Acid rain Ozone layer depletion, Nuclear accidents. 1.4 Concept of 4R (Reduce, Reuse, Recycle and Recover), 1.5 Public awareness about environment.
Unit– II Energy Resources	2a. List various natural resources. 2b. Describe Renewable, Nonrenewable and Cyclic resources. 2c. State the causes and effects of depletion of resources. 2d. State advantages and disadvantages of forms of energy. 2e. Select appropriate solutions of efficient use of energy. 2f. State the impacts of overuse of natural resources.	2.1 Natural Resources - Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources. 2.2 Renewable, Non-renewable and Cyclic Resources. 2.3 Causes and effects of depletion of resources. 2.4 Energy forms (Conventional and non-conventional). 2.5 Present global energy use and future demands. 2.6 Energy conservation. 2.7 Over use of natural resources and its impacts on environment.
Unit- III Ecosystem and Biodiversity	3a. State the aspects and division of ecosystem. 3b. State the general characteristics and function of ecosystem. 3c. List levels of biodiversity. 3d. Enlist the endangered species. 3e. Describe value of biodiversity. 3f. Suggest methods for biodiversity conservation.	3.1 Ecosystem - Definition , Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem. 3.2 Biodiversity - Definitions, Levels, Value and loss of biodiversity. 3.3 Biodiversity assessment initiatives in India. 3.4 Threats and Hotspots of biodiversity. 3.5 Conservations of biodiversity - objects, various laws.
Unit– IV Environmental Pollution	4a. Define pollution. 4b. State the sources of pollution. 4c. State the effects of land pollution on environment and lives. 4d. State various units and their functions of water treatment plant. 4e. State the needs of water conservation.	4.1 Definition of pollution, types- Natural & Artificial (Man- made). 4.2 Soil / Land Pollution – Causes and effects on environment and lives , preventive measures. 4.3 Water Pollution - Sources of water (surface and sub surface), sources of water pollution, effects on environment and lives, preventive measures, BIS water quality

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	4f. State the impacts of sewage. 4g. State various units and their functions of sewage treatment plant. 4h. State sources and effects of air pollution. 4i. Describe various methods to prevent air pollution. 4j. State sources and effects of noise pollution. 4k. Describe preventive measures for noise pollution. 4l. State characteristics of solid waste. 4m. State the impacts of solid waste. 4n. Describe incineration, RDF and sanitary landfilling. 4o. State the standards limiting/controlling values of various types of pollution.	standards, flow diagram of water treatment plant, Water conservation. 4.4 Wastewater - Generation(domestic and industrial), Impacts, flow diagram of sewage treatment plant, CPCB norms of sewage discharge. 4.5 Air pollution - Causes, effects, prevention, Ambient air quality standards. 4.6 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city. 4.7 Municipal Solid Waste, Bio-medical waste and E-waste - Sources, generation, characteristics, effects, and methods to manage.
Unit-V Social Issues and Environmental Education	5a. Elaborate article (48-A) and (51-A (g)) 5b. Enlist various acts on environment and its provisions. 5c. State the roles and responsibilities of CPCB. 5d. Define sustainable development, and EIA. 5e. Describe rain water harvesting and groundwater recharge. 5f. Differentiate between formal and non formal education.	5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental protection and prevention acts, CPCB and MPCB norms and responsibilities, The role of NGOs. 5.2 Concept of sustainable development, EIA and environmental morality. 5.3 Management Measures - Rain Water harvesting, Ground water recharge, Green Belt Development, Use of Renewable energy, water shed management, interlinking of rivers. 5.4 Role of information technology in environment and human health.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Environment	06	4	6	-	10
II	Energy Resources	10	4	8	4	16

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
III	Ecosystem and Biodiversity	08	4	4	4	12
IV	Environmental Pollution	16	8	8	4	20
V	Social Issues and Environmental Education	08	4	4	4	12
	Total	**48**	**24**	**30**	**16**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Plant and adopt a tree in your nearby locality/Polytechnic campus and prepare report about its growth and survival after six months with photos.
b. Organize seminar on air pollutants of relevant MIDC area/vehicle
c. Organize poster exhibition about global warming and ozone depletion.
d. Visit a nearest water purification/effluent treatment plant.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various topics.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so

that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

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

a. Prepare a report on visit to PUC Center.
b. Visit a near by RO plant and prepare detail technical report.
c. Prepare report on Household water filtration unit
d. Prepare a list of polluted natural resources which are responsible for pollution and collect information on how to manage them .
e. **Collection of Data from Hospital: Collect** everyday information on percentage of solid hazardous and toxic waste for two month
f. **Visit of Municipal Effluent Treatment Plant:** Visit effluent treatment plant and prepare report on waste management.
g. **Visit of Water Treatment Plant:** Visit water treatment plant and prepare report on various units of water treatment and its management.
h. **Preparation of report**: Prepare the chart of solid waste management showing effects on environment.
i. **And any other relevant topic related to course**

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Basic Environmental Sciences	Michael Allaby	Routledge Publication, 2nd Edition, 2000, ISBN: 0-415-21176-X
2	Environmental Science	Y. K. Singh	New Age International Publishers, 2006, ISBN: 81-224-2330-2
3	Environmental Studies	Erach Bharucha	University Grants Commission, New Delhi
4	Environmental Studies	Rajagopalan	Third Edition, Oxford University Press, USA, ISBN: 9780199459759, 0199459754
5	A text book of Environmental Science	Arvind Kumar	APH Publishing New Delhi
6	A text book of Environmental Studies	Shashi Chawla	Tata Mc Graw-Hill New Delhi

14. SOFTWARE/LEARNING WEBSITES

a. www.eco-prayer.org
b. www.teriin.org
c. www.cpcb.nic.in

d. www.indiaenvironmentportal.org.in
e. www.whatis.techtarget.com
f. www.sustainabledevelopment.un.org
g. www.conserve-energy-future.com

Program Name : **Computer Engineering Program Group / Diploma in Artificial Intelligence and Machine Learning / Diploma in Computer Hardware & Maintenance / Diploma in Electronics and Computer Engineering / Diploma in Cloud Computing and Big Data**

Program Code : **CO/CM/IF/CW/AN/HA/TE/BD**

Semester : **Fifth**

Course Title : **Operating System**

Course Code : **22516**

1. RATIONALE

An Operating System is basically a system program that controls the execution of application programs and acts as an interface between applications and the computer hardware. It manages the computer system resources to be used in an efficient manner. This course enables to learn internal functioning of operating system and will help in identifying appropriate Operating System for given applications/task. This course is also a prerequisite for the group of courses included in 'Cloud Infrastructure Maintenance' Elective group

2. COMPETENCY

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

- **Manage operations of Operating System.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Install operating system and configure it.
b. Use operating system tools to perform various functions.
c. Execute process commands for performing process management operations.
d. Apply scheduling algorithms to calculate turnaround time and average waiting time.
e. Calculate efficiency of different memory management techniques.
f. Apply file management techniques.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

***Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P – Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

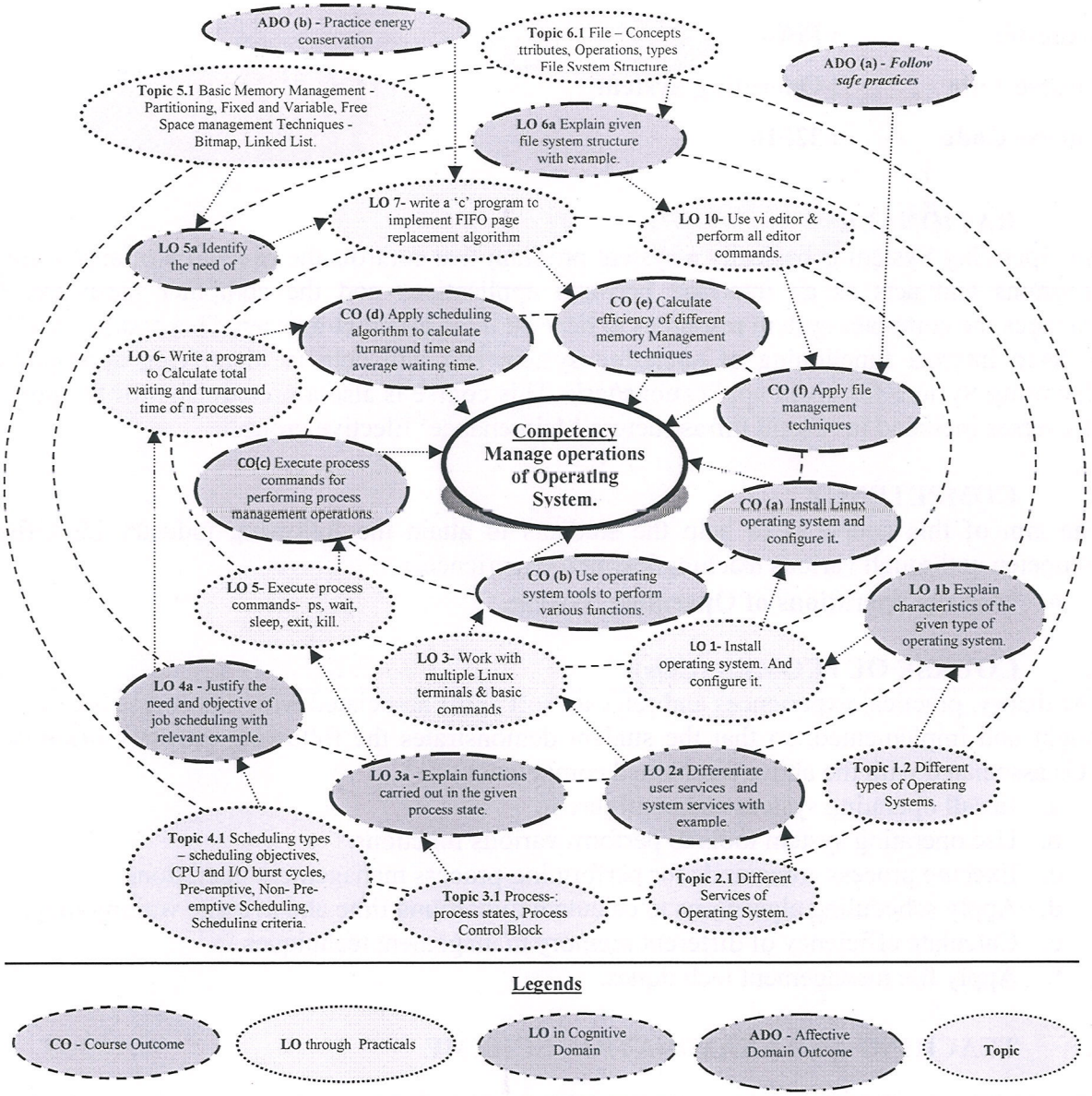


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

Sr. No.	Practical Outcomes (PrOs	Unit No.	Approx. Hrs. Required
1.	Install and configure Linux (or alike) operating system.	I	02*
2.	Execute general purpose commands date, time, cal, clear, banner	I	02*

Sr. No.	Practical Outcomes (PrOs	Unit No.	Approx. Hrs. Required
	tty, script, man.		
3.	Work with multiple linux terminals and basic commands: who, who am I, login, passwd, su, pwd.	II	02*
4.	a) Use Operating services(Editor, GUI, File handling.) b) Run commands to start, stop, and restart the specified service in Linux.	II	02*
5.	Execute process commands- ps, wait, sleep, exit, kill.	III	02*
6.	Write a program to calculate total waiting and turnaround time of n processes with First Come First Serve CPU scheduling algorithm.	IV	02
7.	Write a 'C' program to implement FIFO page replacement algorithm.	V	02
8.	Execute file and directory manipulation commands – ls, rm, mv, cp, join, split, cat (file saving and redirection operator), head, tail, touch,	VI	02*
9.	Execute file and directory manipulation commands – diff, comm., pr, chmod, mkdir, rmdir, cd, pwd, dir, cmp. (Use wild card character).	VI	02*
10.	Execute text processing tr, wc, cut, paste, spell, sort, grep, more.	VI	02*
11.	Use vi editor and perform all editor commands.	VI	04*
12.	Write and execute Shell Script by using following Control statements features- "if" statement	VI	02*
13.	Write and execute Shell Script by using following Control statements features- "for" statement, exit, break, continue	VI	02*
14.	Write Shell script to find out whether - Given file exists?	VI	02
15.	Write Shell script to find out whether - File has read, write, and execute permissions?	VI	02*
	Total		**32**

Note

*i. In the above listed example wherever **Linux** as operating system is mentioned, it could be replaced with other alike operating systems such as **Ubuntu, CentOs** or any other OS.*

ii. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Application Level' of Bloom's Taxonomy' as generally required by the industry.*

iii. The 'Process' and 'Product' related skills associated with each PrO are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	Installation/configuration of operating system	25
b.	Correctness of Executing various commands	25
c.	Writing and executing programs to get desired output	20
d.	Debugging the program	15
e.	Submit journal report in time	15
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO S. No.
1	Computer system (Any computer system with basic configuration)	All
2	Linux or alike operating system such as Ubuntu, CentOS or any other.	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Overview of Operating System	1a. Explain the functioning of given component of OS. 1b. Explain characteristics of the given type of operating system. 1c. Identify type of operating system suitable for the given type of application. 1d. Execute command on command line for the given task.	1.1 Operating System – Concept, Components of operating system, operations of OS: Program Management, Resource management, Security and protection. Views of OS: User view, System View 1.2 Different Types of Operating systems- Batch operating system, Multi Programmed, Time Shared OS, Multiprocessor Systems, Distributed Systems, Real time systems. Mobile OS (Android,iOS). 1.3 Command line based OS – DOS, UNIX GUI based OS –WINDOWS, LINUX.
Unit– II Services and Componen	2a. Start, stop, and restart the given service in Linux. 2b. Explain use of the given System call of specified OS.	2.1 Different Services of Operating System. 2.2 System Calls- Concept, types of system calls 2.3 OS Components: - Process Management, Main Memory

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
ts of Operating System	2c. Explain process the OS follows in managing the given resource. 2d. Explain use of the given operating system tool.	Management, File Management, I/O System management, Secondary storage management. 2.4 Use of operating system tools- user management, security policy, device management, performance monitor, task scheduler
Unit– III Process Management	3a. Explain functions carried out in the given process state. 3b. Describe the function of the given component of process stack in PCB. 3c. Explain characteristics of the given multithreading model. 3d. Describe method of executing the given process command with example.	3.1 Process-: process states, Process Control Block (PCB). 3.2 Process Scheduling- Scheduling Queues, Schedulers, Context switch. 3.3 Inter-process communication (IPC): Introduction, shared memory system and message passing system. 3.4 Threads - Benefits, users and kernel threads, Multithreading Models - Many to One, One to One, Many to Many. 3.5 Execute process commands- like ps, wait, sleep, exit, kill
Unit-IV CPU Scheduling and Algorithms	4a. Justify the need and objective of given job scheduling criteria with relevant example. 4b. Explain with example the procedure of allocating CPU to the given process using the specified OS. 4c. Calculate turnaround time and average waiting time of the given scheduling algorithm. 4d. Explain functioning of the given necessary condition leading to deadlock.	4.1 Scheduling types – scheduling Objectives, CPU and I/O burst cycles, Pre-emptive, Non- Pre-emptive Scheduling, Scheduling criteria. 4.2 Types of Scheduling algorithms - First come first served (FCFS), Shortest Job First (SJF), Shortest Remaining Time(SRTN), Round Robin (RR) Priority scheduling, multilevel queue scheduling. 4.3 Deadlock - System Models, Necessary Conditions leading to Deadlocks, Deadlock Handling - Preventions, avoidance.
Unit –V Memory Management	5a. Describe the working of specified memory management function. 5b. Explain characteristic of the given memory management techniques. 5c. Write algorithm for the given page replacement technique. 5d. Calculate Page fault for the given page reference string.	5.1 Basic Memory Management - Partitioning, Fixed and Variable, Free Space management Techniques - Bitmap, Linked List. 5.2 Virtual Memory – Introduction to Paging, Segmentation, Fragmentation, and Page fault. 5.3 Page Replacement Algorithms: FIFO, LRU, Optimal.
Unit-VI File Management	6a. Explain structure of the given file system with example. 6b. Describe mechanism of the given file access method. 6c. Explain procedure to create and access directories and assign the given files access	6.1 File – Concepts, Attributes, Operations, types and File System Structure. 6.2 Access Methods – Sequential, Direct, Swapping, File Allocation Methods- Contiguous, Linked, Indexed. 6.3 Directory structure – Single level, two levels, tree-structured directory, Disk

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	permissions. 6d. Explain features of the given Raid level structure of hard disk.	Organization and disk Structure- Physical structure, Logical structure, Raid structure of disk, raid level 0 to 6.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Overview of Operating System	06	02	02	04	08
II	Services and Components of Operating System	06	02	04	04	10
III	Process Management	10	02	04	08	14
IV	CPU Scheduling and Algorithms	10	02	04	08	14
V	Memory Management	10	02	04	08	14
VI	File Management	06	02	04	04	10
	Total	**48**	**12**	**22**	**36**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal of practicals.
b. Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

e. Guide student(s) in undertaking micro-projects.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

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

a. 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 example.
b. Make a comparative statement to calculate page fault for given page reference string by using different page replacement algorithms.
c. Prepare help guide using shell script for all the major Linux commands.
d. Make a comparative chart to calculate total waiting and turnaround time of n processes with different CPU scheduling algorithm.

Any other micro-projects suggested by subject faculty on similar line.
(Use features of 'C' or shell scripts to develop above listed applications)

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Operating System Concepts	Silberschatz, Galvin	John Wiley and Sons, Ninth Edition, 2015, ISBN: 978-51-265-5427-0
2	Operating System	Godbole, Achyut S.	Tata McGraw Hill Education, 2015, ISBN: 9780070591134
3	Operating Systems: Internals and Design Principles	Stallings ,William	Pearsons, 8 edition 2015 ISBN: 978-0133805918
4	Unix Concept and Programming	Das, Sumitabha	McGraw Hill education, 2015, ISBN: 978-0070635463
5	Operating System	Dhamdhere, Dhanjay M.	McGraw Hill, 2015 ISBN-MC 978-1-25-900558-9
6	Operating System	Dr. Rajendra Kawale	Devraj Publications,Mumbai ISBN 978-81-935551-1-4

14. SOFTWARE/LEARNING WEBSITES

a) www.cs.wisc.edu/~ bart/537 lecture notes-University of Wisconsin Madison.
b) www.cs.kent.edu/osf o3/notes/index.html- Vilinius Gediminas Technical University
c) http://www.howstuffworks.com/operating-system1.htm
d) www.computerhope.com/jargon/o/os.htm
e) www.en.wikipedia.org/wiki/Operating system
f) https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/12_MassStorage.html

Program Name : **Computer Engineering Program Group / Diploma in Artificial Intelligence and Machine Learning / Diploma in Cloud Computing and Big Data / Diploma in Computer Hardware & Maintenance**

Program Code : **CO/CM/IF/CW/AN/BD/HA**

Semester : **Fifth**

Course Title : **Client Side Scripting Language**

Course Code : **22519**

1. RATIONALE

JavaScript is limited featured client side programming language. JavaScript runs at the client end through the user's browser without sending messages back and forth to the server. It is widely used by the web developers to do things such as build dynamic web pages, respond to events, create interactive forms, validate data that the visitor enters into a form, control the browser etc. This course helps student to create highly interactive web pages using these features.

2. COMPETENCY

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

- **Develop Dynamic Web Pages using JavaScript.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a) Create interactive web pages using program flow control structure.
b) Implement Arrays and functions in Java script.
c) Create event based web forms using Java script.
d) Use JavaScript for handling cookies.
e) Create interactive webpage using regular expressions for validations.
f) Create Menus and navigations in web Pages.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): *Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.*
Legends: L*-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *-Practical;* ***C*** *– Credit,* ***ESE*** *-End Semester Examination;* ***PA*** *- Progressive Assessment.*

5. COURSE MAP(with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

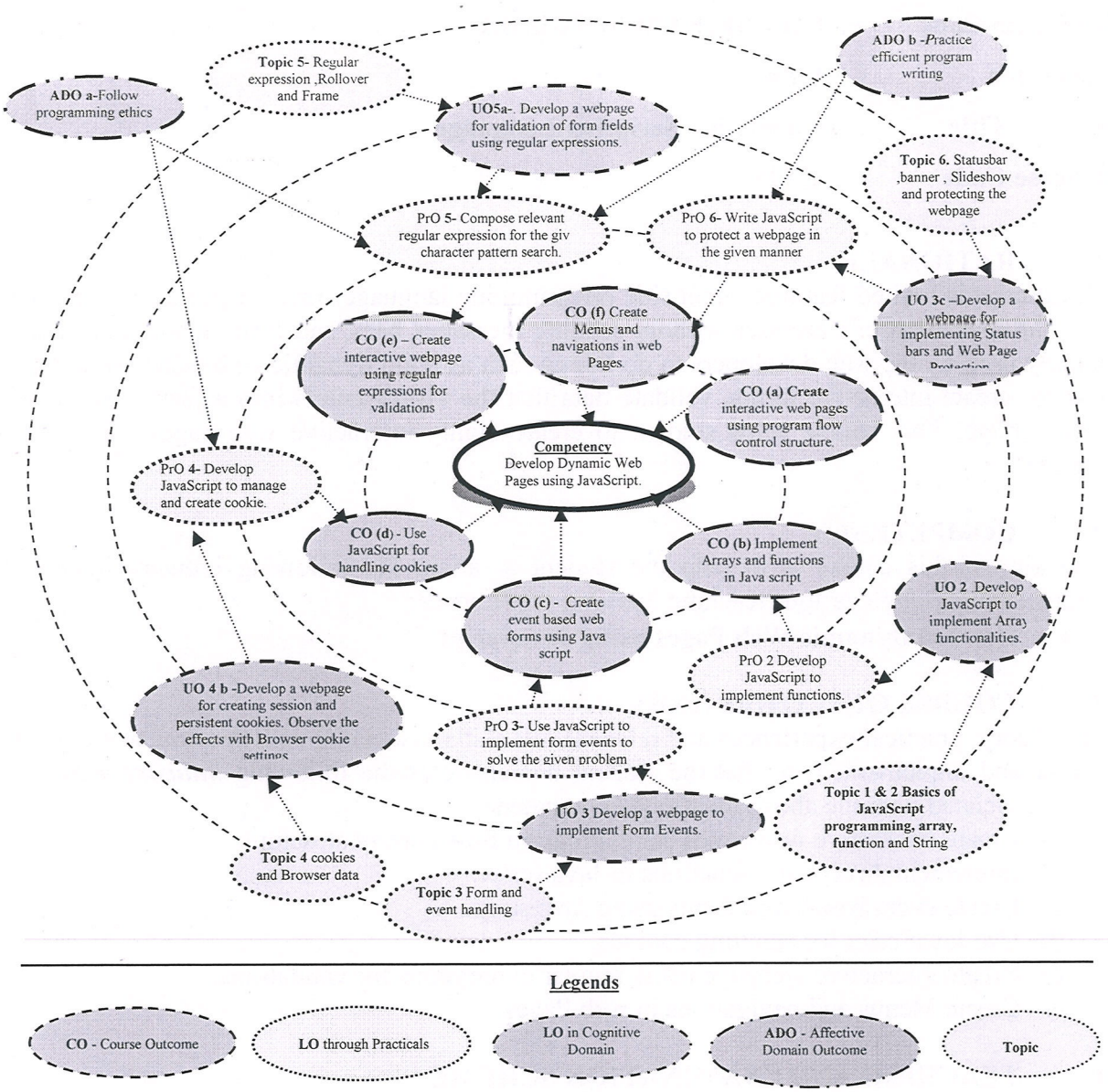


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Write simple javascript with HTML for arithmetic expression evaluation and message printing	I	02
2.	Develop JavaScript to use decision making and looping statements.	I	02*
3.	Develop JavaScript to implement Array functionalities.	II	02*
4.	Develop JavaScript to implement functions.	II	02*

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
5.	Develop JavaScript to implement strings.	II	02
6.	Create a webpage using Form Elements.	III	02*
7.	Create a webpage to implement Form Events. Part-I	III	02*
8.	Create a webpage to implement Form Events. Part-II	III	02*
9.	Develop a webpage using Intrinsic Java Functions.	III	02*
10.	Develop a webpage for creating session and persistent cookies. Observe the effects with Browser cookie settings.	IV	02*
11.	Develop a webpage for placing the Window on the screen and working with child window.	IV	02*
12.	Develop a webpage for validation of form fields using regular expressions.	V	02*
13.	Create a webpage with Rollovers effect.	VI	02
14.	Develop a webpage for implementing Menus.	VI	02*
15.	Develop a webpage for implementing Status bars and Web Page Protection.	VI	02
16.	Develop a webpage for implementing Slideshow, banner.	VI	02*
	Total		**32**

Note:

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Application Level' of Bloom's Taxonomy' as generally required by the industry.*

ii. 50% of Lab assignments must be done using traditional editor and run in different browsers so as to build up fundamental understanding capabilities of students.

iii. The 'Process' and 'Product' related skills associated with each PrO are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Use of relevant tags and attributes	10
2	Correctness of Coding.	40
4	Testing and Debugging of the Program.	30
5	Appearance of Program Output.	10
6	Submission of report in time.	10
Total		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S.No.
1	Browser and Notepad/any Text editor/	All
2	Free Web page Designing Tool	All
3	Any IDE like Eclipse	All

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Basics of JavaScript Programming	1a. Create object to solve the given problem. 1b. Develop JavaScript to implement the switch-case statement for the given problem. 1c. Develop JavaScript to implement loop for solving the given iterative problem. 1d. Display properties of the given object using getters and setters. 1e. Develop program using basic features of JavaScript to solve the given problem.	1.1 Features of JavaScript 1.2 Object Name, Property, method, Dot syntax, main event. 1.3 Values and Variables 1.4 Operators and Expressions- Primary Expressions, Object and Array initializers, function definition expression, property access expressions, invocation expressions. 1.5 If Statement, if…else, if..elseif, nested if statement. 1.6 Switch…case statement 1.7 Loop statement – for loop, for...in loop, while loop, do…while loop, continue statement. 1.8 Querying and setting properties and deleting properties, property getters and setters.
Unit-II Array, Function and String	2a. Create array to solve the given problem. 2b. Perform the specified string manipulation operation on the given String(s). 2c. Develop JavaScript to implement the given function. 2d. Develop JavaScript to convert the given Unicode to character form. 2e. Develop JavaScript to convert the given character	2.1 Array - declaring an Array, Initializing an Array, defining an Array elements, Looping an Array, Adding an Array element, sorting an Array element, Combining an Array elements into a String, changing elements of an Array, Objects as associative Arrays 2.2 Function – defining a function, writing a function, adding an arguments, scope of variable and arguments, 2.3 Calling a function – calling a function with or without an argument, calling function from HTML, function calling

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	to Unicode and vice-versa.	another function. Returning a value from a function 2.4 String – manipulate a string, joining a string, retrieving a character from given position, retrieving a position of character in a string, dividing text, copying a sub string, converting string to number and numbers to string, changing the case of string, finding a Unicode of a character-charCodeAt(), fromCharCode().
Unit– III Form and Event Handling	3a. Write JavaScript to design a form to accept input values for the given problem. 3b. Use JavaScript to implement form events to solve the given problem. 3c. Develop JavaScript to dynamically assign specified attribute value to the given form control. 3d. Use the given intrinsic function with specified parameters.	3.1 Building blocks of a Form, properties and methods of form, button, text, text area, checkbox, radio button, select element. 3.2 Form events- mouse event, key events. 3.3 Form objects and elements. 3.4 Changing attribute value dynamically. 3.5 Changing option list dynamically 3.6 Evaluating checkbox selection 3.7 Changing a label dynamically 3.8 Manipulating form elements 3.9 Intrinsic JavaScript functions, disabling elements, read only elements.
Unit– IV Cookies and Browser Data	4a. Create cookies based on the given problem. 4b. Develop JavaScript to manage a cookie in the given manner. 4c. Write JavaScript to manipulate the specified attributes of window object in the given manner. 4d. Write JavaScript to create browser history of the given object.	4.1 Cookies – basic of cookies, reading a cookie value, writing a cookie value, creating a cookies, deleting a cookies, setting the expiration date of cookie 4.2 Browser – opening a window, giving the new window focus, window position, changing the content of window, closing a window, scrolling a web page, multiple windows at once, creating a web page in new window, JavaScript in URLs, JavaScript security, Timers, Browser location and history.
Unit –V Regular Expression, Rollover and Frames	5a. Compose relevant regular expression for the given character pattern search. 5b. Develop JavaScript to implement validations using the given regular expression.	5.1 Regular Expression - language of regular expression, finding non matching characters, entering a range of characters, matching digits and non digits, matching punctuations and symbols, matching words, replacing a

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	5c. Create frames based on the given problem. 5d. Create window object as per the given problem. 5e. Develop JavaScript for creating rollover effect for the given situation.	the text using regular expressions, returning the matched characters, regular expression object properties. 5.2 Frames – create a frame, invisible borders of frame, calling a child windows, changing a content and focus of a child window, writing to a child window, accessing elements of another child window. 5.3 Rollover – creating rollver, text rollver, Multiple actions for rollover, more efficient rollover.
Unit –VI Menus, navigation and web page protection	6a. Develop JavaScript to manage the given status bar. 6b. Develop JavaScript to create the given banner. 6c. Develop JavaScript to create the given slide show. 6d. Develop JavaScript to create the given Menu. 6e. Write JavaScript to protect a webpage in the specified manner.	6.1 Status bar- builds a static message, changing the message using rollover, moving the message along the status bar 6.2 Banner –loading and displaying banner advertisement. Linking a banner advertisement to url 6.3 Slide Show – creating a slide show 6.4 Menus- creating a pulldown menu, dynamically changing a menu, validating menu selection, Floating menu, chain select menu, tab menu, pop-up menu, sliding menu, highlighted menu, folding a tree menu, context menu, scrollable menu, side bar menu. 6.5 Protecting web page – hiding your code, disabling the right mouse button, JavaScript, concealing email address. 6.6 Frameworks of javasript and its application

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of JavaScript Programming	10	04	04	04	12
II	Array, Function and String	10	02	04	08	14
III	Form and Event Handling	06	02	04	04	10
IV	Cookies and Browser Data	06	02	02	04	08
V	Regular Expression, Rollover & Frames	08	02	06	06	14
VI	Menus, navigation and web page protection	08	02	04	06	12

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
Total		48	14	24	32	70

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a) Prepare journals based on practical performed in laboratory.
b) Prepare powerpoint presentation or animation for understanding different Client side scripting Concepts.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c) About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d) With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e) Use different Audio Visual materials for Concept understanding.
f) Guide student(s) in undertaking micro-projects.
g) Encourage students to refer different websites to have deeper understanding of the subject.
h) Observe continuously and monitor the performance of students in Lab.
i) 50% of Lab assignments must be done using traditional editor and run in different browsers so as to build up fundamental understanding capabilities of students.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a

seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

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

a) Create a web page that displays buyers information entry form containing name, address, city, pin code, mail Id, Phone Number, product details , payment mode. Frame different validation rules for user inputs. Use JavaScript and regular expressions to perform error checking on user input as per validation rules.

b) Build a simple slide show in JavaScript with six unique images. Design appropriate web page with at least two sections: with slide show in one section. When any image on this slide show is clicked display information about it in other section. Use features for controlling window locations.

c) Design and create web pages of an institute with different sections. Use pulldown menus in one section and implement validation of menu selections. Use other sections for displaying information about respective selected menu item.

d) Create a simple animation in JavaScript : create a basic page showing circle of white marble. Using the setTimeout() method create an animation on the page that that makes an orange marble rotate around this circle by moving the orange marble to the next location in the circle every second. Allow the user to stop the animation by placing the cursor on any marble(use clearTimeout()).

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	JavaScript Demystified	Keogh, Jim	McGraw-Hill, 2015, New Delhi ISBN:0-07-060347-2
2.	Beginning JavaScript	Wilton, Paul	Wily India, New Delhi, 2015, ISBN:0-7645-5587-1
3.	Beginning JavaScript	McPeak, Jeremy and Wilton, Paul	Wily India, New Delhi, 2015, ISBN:81-265-1304-7
4.	JavaScript in 24 hours (SAMS teach yourself)	Moncur, Michael	TechMedia, New Delhi, 2015, ISBN:978-0-672-33608-9

14. SOFTWARE/LEARNING WEBSITES

a) https://www.w3schools.com
b) http://www.nptelvideos.com
c) http://www.tutorialspoint.com.
d) Http://javapoint.com

Program Name : **Computer Engineering Program Group / Diploma in Artificial Intelligence and Machine Learning**

Program Code : **CO/CM/CW/AN**

Semester : **Fifth**

Course Title : **Advanced Database Management Systems (Elective)**

Course Code : **22521**

1. RATIONALE

Advanced database management systems contain comprehensive contents on various concepts related to database systems, database design and management. Broadly it discusses about parallel and distributed database systems, database transactions, big data management and advances in database data. The student will get a detailed introduction about database administration and management, the role of machine learning in big data management. This course includes study of structured and unstructured database like MongoDB, SQL and XML for data management. The concept big data is used in today's information driven business world for managing big data. After learning this subject student will be able to use ADBMS as a backend for developing database.

2. COMPETENCY

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

- **Apply Advanced Database Management Systems concepts using MongoDB and XML**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Differentiate various database architectures.
b. Use Object Oriented and Advanced XML queries on Database.
c. Manipulate data using MongoDB commands.
d. Use Data Mining And Data Warehousing Concepts.
e. Use Big Data Concepts.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): *Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.*

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *– Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment.*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

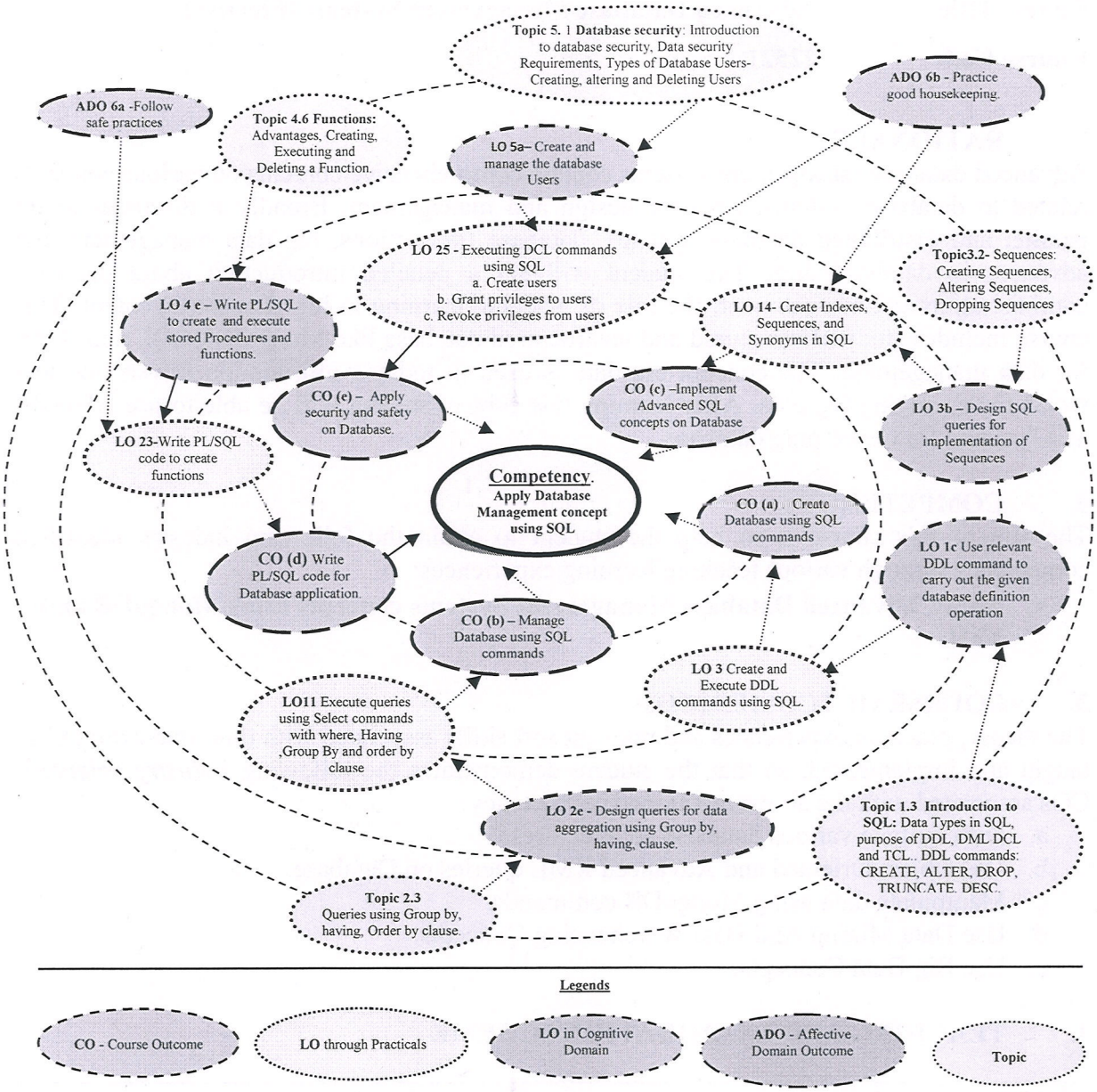


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Implementing Locking protocols	I	02
2.	Install and configure Database system (such as MySQL, MongoDB or any other relational database system)	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Implementing Locking protocols	I	02
3.	Create database using XML attributes and Elements.	II	02
4.	Implement queries based on FLOWER expressions and joins using XQuery.	II	02
5.	Implement queries based on Nested queries and sorting of results using XQuery.	II	02
6.	Implement queries based on functions and types using XQuery.	II	02
7.	Execute queries using structured type in SQL	II	02
8.	Execute queries using type inheritance and table inheritance in SQL	II	02
9.	Implement queries using Array and Multiset types in SQL	II	02
10.	Execute queries using object identity and reference types in SQL	II	02
11.	Design and Develop MongoDB Queries using basic operations	III	02
12.	Implement aggregation Queries using MongoDB	III	02
13.	Implement MongoDB Queries Usinf find() function	III	02
14.	Implement aggregation Queries in MongoDB through MapReduce	III	02
15.	Install and configure Any data mining tool (like WEKA)	IV	02
16.	Make use of installed data mining tool(like WEKA)	IV	02
		Total	**32**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	Installation and configuration of database system	10
b.	Coding of queries and MongoDB programming	40
c.	Quality of result displayed by queries.	30
d.	Answer to sample questions	10
e.	Submit report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Work as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs

according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

17. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Exp. S. No.
1.1	Computer system (Any computer system with basic configuration)	All
1.2	Any RDBMS software (MySQL/Oracle/SQL server/MongoDB or any other)	All

18. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Database Architecture	1a. Describe the given client-server Database Model. 1b. Use the given locking protocols for concurrency control. 1c. Apply parallel and distributed database techniques in given situation. 1d. Differentiate between Parallel and Distributed Databases.	1.1 Introduction to client-server Database Model: Two-Tier Client server model, Three-Tier Client server model. 1.2 Concurrency Control Techniques: Concurrency control protocols: Locked Based protocols, granting of locks, Two Phase Locking protocol. 1.3 Introduction to parallel databases: Parallel database system architecture, Types of parallelism, Parallel Database Implementation. 1.4 Introduction to distributed databases: Distributed database system architecture, Benefits of distributed database system, Issues with distributed database systems.
Unit II- Object Based Databases and XML	2a Create the given object based database using SQL 2b Write given SQL queries using Table Inheritance 2c Write given SQL queries using Array and Multiset. 2d Implement SQL queries to refer the given object using object identity. 2e Write XML queries on given data.	2.1 Object Based Databases overview 2.2 Complex data types 2.3 Structured types and inheritance in SQL 2.4 Table inheritance 2.5 Array and multiset types in SQL 2.6 Object identity (OI) and reference types in SQL 2.7 XML: Introduction, structure of XML data, XML document schema ,Xpath, XQuery FLOWER Expressions, Joins,Nested Queries, Sorting of functions, Functions and types.
Unit– II	3a. Differentiate structured and	3.1 Structured versus Unstructured Data

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Advanced Database Techniques	Unstructured Data. 3b. Use NoSQL database to solve given queries. 3c. Use MongoDB to solve given queries. 3d. Differentiate SQL and NoSQL databases. 3e. Write query to execute find() function on given data. 3f. Implement basic operations performed on MongoDB shell on given data. 3g. Write query using aggregate() method on given data.	3.2 NoSQL database concepts: Types of NoSQL databases, NoSQL data modeling, Benefits of NoSQL, comparision between SQL and NoSQL database system. 3.3 NoSQL using MongoDB: Introduction to MongoDB Shell, Running the MongoDB shell, MongoDB client, Basic operations with MongoDB shell, Basic Data Types ,Arrays, Embedded Documents 3.4 Querying with MongoDB: find() function, specifying which keys to return, query criteria, OR queries, Types specific querying 3.5 Aggregation Introduction: Aggregation Pipeline, Aggregation using Map reduce, Single purpose aggregation
Unit –IV Advances in Databases	4a. Define data mart, meta data 4b. Explain architecture of data warehouse 4c. Analyze given data using data mining. 4d. Describe the features of BI and BI components framework. 4e. Explain use of spatial databases in a given situation.	4.1 Introduction to Data Warehouse :Characteristics, Types of Data Warehouse Architecture, Data Marts, Data Warehousing Lifecycle, Data Warehouse Development 4.2 Introduction to Data Mining Techniques: Data mining technology and its relation to data warehousing, Association rules, classification and clustering, Applications of data mining. 4.3 Introduction to business Intelligence: Features, frameworks, Types and approaches for machine learning 4.4 Introduction to Multimedia Databases, Mobile Databases and digital databases
Unit-V Big Data Management	5.a Analyze the given situation for the use of Big data. 5.b Describe the given architecture of Hadoop. 5.c Explain given components of Hadoop. 5.d Explain use of cloudera in given situation. 5.e Explain given features of R-programming.	5.1 Big Data 5.2 Introduction to Hadoop: Building Blocks and Components, Hadoop architecture, HBase, HIVE, Solid -State Drive 5.3 Cloudera, Oracle cloud, 5.4 Introduction to R-programming

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Database Architecture	08	04	04	04	12
II	Object Based Databases and XML	14	04	04	10	18
III	Advanced Database Techniques	12	06	04	06	16
IV	Advances in Databases	08	02	08	04	14
V	Big Data Management	06	02	04	04	10
Total		**48**	**18**	**24**	**28**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.
i. Demonstrate students thoroughly before they start doing the practice.
j. Encourage students to refer different websites to have deeper understanding of the subject.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so

that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

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

a. Develop and maintain XML database for Employee information System.
b. Design and develop MongoDB database for library management system.
c. Perform preprocessing of data using any data mining tool (like WEKA).
d. Install and configure Hadoop.
e. Perform database connectivity with any front end tool.

13. SUGGESTED LEARNING RESOURCES :

S. No.	Title of Book	Author	Publication
1	Database Management Systems Application	Kogent Learning Solutions Inc.	Dreamtech Press 2014, ISBN-978-93-5119-476-7
2	Database System Concepts	Korth Henery	Tata McGraw Hill Education, 6th Edition ,ISBN -13:978-93-329-0138-4
3	Complete Reference: Mysql	Vaswani Vikram	McGraw Hill Education, ISBN-13: 9780070586840
4	SQL, PL/SQL The Programming Language of ORACLE	Bayross Ivan	BPB Publications, 3rd Edition ISBN-13: 978-8176569644
5	Database Management	Dr. Rajendra Kawale	Devraj Publications , Mumbai ISBN 978-93-86492-00-5

14. SOFTWARE/LEARNING WEBSITES

a) https://www.tutorialspoint.com
b) https://www.w3schools.com
c) http://db.ucsd.edu/static/cse132b-sp01/oql.htm
d) https://docs.mongodb.com/manual/tutorial/install-mongodb-on-windows/
e) http://www.cs.stir.ac.uk/courses/CSC9T6/practicals/1%20Data%20Mining/1%20-%20Weka%201.pdf

Program Name : **Diploma in Artificial Intelligence and Machine Learning**
Program Code : **AN**
Semester : **Fifth**
Course Title : **Fundamental of AI & ML Algorithm**
Course Code : **22593**

1. RATIONALE

Artificial Intelligence (AI) is a big field; AI is one of the newest fields in science and engineering. This course will cover the basic of AI and ML and its architecture, Life cycle of Machine Learning, different searching techniques. AI as the study of agents that receive percepts from the environment and perform actions.

2. COMPETENCY

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

- **Classify real world problem and apply knowledge of AI and ML**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Describe the foundations of AI and Study different types of AI agents.
b. Analyze and illustrate how search algorithms play vital role in problem solving
c. Use different techniques knowledge representation for solving real world problems
d. Describe Machine Learning Life Cycle and analyze different forms of data
e. Analyze the data using different learning methods.
f. Use different classification and regression techniques.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(**) *marks should be awarded on the basis of internal end semester theoryexam of 50 marks based on the specification table given in S. No. 9.*
*(~²): For the **practical only courses,** the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*
Legends: L Lecture; **T** Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **ESE** -End Semester Examination; **PA** - Progressive Assessment, **#**: No Theory Examination

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

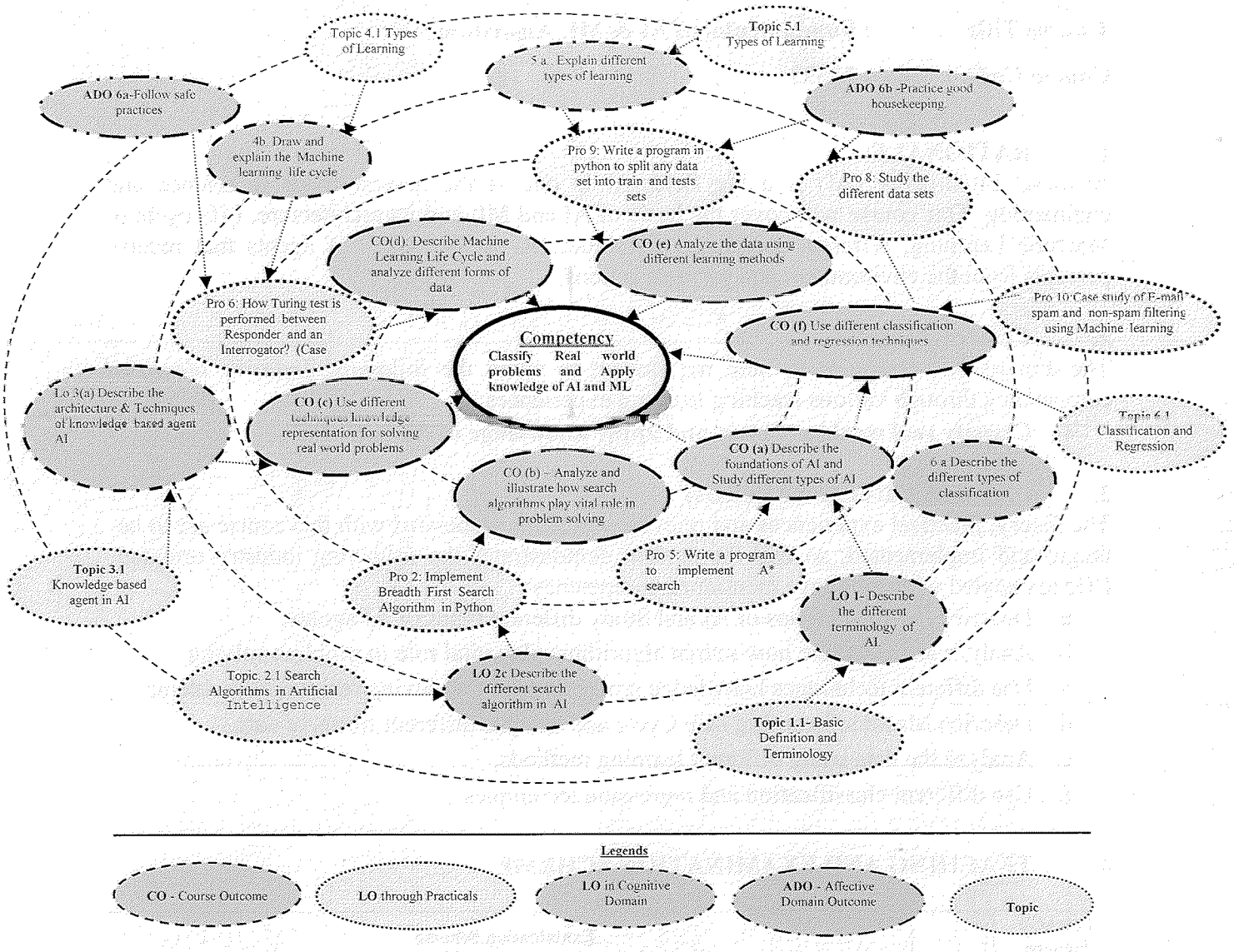


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs) are to be developed andassessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
1	a. Installation of Python (Any IDE) b. Installation of Python scikit learn for ML c. Use of google colab (https://colab.research.google.com/)	I	02*
2	Implement Breadth first Search Algorithm (Uninformed)in Python	II	04*
3	Implement Depth first Search Algorithm(Uninformed) in Python	II	02

S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
4	Write a program to implement Greedy best-first (Informed Type) search algorithm in python	II	04
5	Write a program to implement A* search (Informed Type) algorithm in Python	II	02*
6	Case study on: How Turing test is performed between Responder and an Interrogator?	III	02*
7	Study the different data set finders e.g. Google Dataset Search, Kaggle etc…	IV	02*
8	Build model on following data sets in various domains. a. Machine learning data set: e.g. Credit Card Fraud Detection Dataset b. NLP data Sets: eg. Twitter Dataset ,HotspotQA Dataset	IV	02*
9	Write a program in python to split any data set into train and tests sets	IV	04*
10	Case study of E-mail spam and non-spam filtering using Machine learning	V,VI	04*
11	Implementation of Simple Linear Regression using Python	VI	02*
12	Implementation of Multiple Linear Regression using Python	VI	02
	Total		**32**

'': compulsory practicals to be performed.*

Note

i. *Given in above tables is suggestive list of practical exercises. Teachers can design other similar exercises.*

ii. *Assessment of the 'Process' and 'Product' related skills in the laboratory/workshop/field work should be done as per suggested sample below:*

S.No.	Performance Indicators	Weightage in %
1	Import packages and Libraries of Python.	20
2	Use Python to create, edit, assemble and link the programs.	40
3	Debug, test and execute the programs	20
4	Able to answer oral questions.	10
5	Submission of report in time.	10
	Total	**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

a. Handle command prompt environment.
b. Experiment with Python
c. Plan, develop, assemble, link, debug and test the programs.
d. Demonstrate working as a leader/a team member.
e. Maintain tools and equipment.
f. Follow ethical practices.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

- 'Valuing Level' in 1st year

- 'Organizing Level' in 2nd year and
- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Expt. S.No.
1	Hardware: Personal computer, (i5 preferable), RAM minimum 8 GB onwards.	For all Experiments
2	Operating system: Windows 10 onward	
3	Software: Editor: Python setup	

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopicsshouldbetaught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Introduction to AI	1a. Describe the different terminology of AI. 1b. Differentiate between AI vs ML. 1c. List the different types of AI agent 1d. Describe the structure of agents. 1e. Explain the turning test in AI	1.1 Basic Definition and Terminology: a. Foundation and Evaluation of AI b. Scope of AI c. Overview of AI Problems d. Components of AI e. Types of AI f. Application of AI g. AI vs ML 1.2 Intelligent Agent in AI: a. Types of AI agent b. Concept of Rationality c. Nature of environment d. Structure of agents e. Turning Test in AI
Unit-II Problem Solving	2a. State the different types of search algorithm 2b. Explain different Heuristic Search Techniques. 2c. Describe the properties of A* algorithm 2d. Describe the Constraint Satisfaction problem	2.1 Search Algorithms in Artificial Intelligence: a. Terminologies b. Properties of search Algorithms c. Types of search algorithms: uninformed search and informed search, State Space search 2.2 Heuristic Search Techniques: a. Generate-and-Test; b. Hill Climbing; c. Properties of A* algorithm, d. Best-first Search; e. Problem Reduction 2.3 Beyond Classical Search:

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		a. Local search algorithms and optimization problem, b. Local search in continuous spaces, c. Searching with nondeterministic action and partial observation, d. Online search agent and unknown environments.
Unit-III Knowledge and Reasoning	3a. Describe the architecture and techniques of knowledge based agent in AI 3b. Explain forward and backward chaining in AI 3c. Explain the different types of Reasoning in AI	3.1 Knowledge-Based Agent in Artificial intelligence: a. Architecture, b. Approaches to designing a knowledge-based agent knowledge representation: c. Techniques of knowledge representation, Propositional logic, d. Rules of Inference e. First-Order Logic, f. Forward Chaining, And backward chaining in AI, 3.2 Reasoning in Artificial intelligence: a. What is Reasoning? b. Types of Reasoning 3.3 Probabilistic reasoning in AI a. Uncertainty b. Causes of Uncertainty c. Need of probabilistic reasoning in AI d. d. Bayes' Theorem.
Unit – IV Introduction to ML	4a. Describe the history and evaluation of ML 4b. Draw and explain the Machine learning life cycle 4c. Explain different forms of data 4d. Explain different data preprocessing methods	4.1 History and Evaluation of ML 4.2 Machine Learning life Cycle. a. Gathering data b. data preparation c. data Wrangling d. Data Analysis e. Train Model f. Test Model g. Deployment 4.3 Different forms of data: a. Statistics b. Data Mining c. Data Analytics d. Statistics Data e. Statistics vs. Data Mining vs. f. Data Analytics vs. Data Science 4.4 Dataset for ML 4.5 Data Cleaning : Missing Data, Outliers
Unit– V Types of Learning	5a. Explain different types of learning 5b. Introduce the different	5.1 Types of Learning: a. Supervised b. Unsupervised

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	types of supervised machine learning algorithm 5c. Introduce the different Unsupervised learning algorithm 5d. Describe the dimensionality reduction.	c. Semi-Supervised Learning 5.2 Supervised Learning: a. Learning a Class from Examples, b. Introduction of different types of supervised Machine Learning Algorithms 5.3 Unsupervised: a. Introduction of different Types of Unsupervised Learning Algorithm, 5.4 Model Evaluation a. Training Vs Testing b. Positive and Negative Class Cross-validation
Unit– VI Classification & Regression	6a. Describe the different types of classification 6b. Describe the assessing performance of Regression 6c. Differentiate between overfitting and under fitting 6d. Describe different types of regression	6.1 Linear Regression: a. Assessing performance of Regression – b. Error measures, c. Overfitting and Under fitting, d. Catalysts for Overfitting, 6.2 Multiple Linear Regression: Multiple Linear regression equation Implementation of multiple linear regression 6.3 Metrics for Regression a. Mean Squared Error (MSE). b. Root Mean Squared Error (RMSE). c. Mean Absolute Error (MAE) 6.4 Logistic Regression a. Binary and Multiclass Classification: b. Assessing c. Classification Performance, d. Handling more than two classes, e. Multiclass Classification- f. One vs One, g. One vs Rest. 6.5 Metrics for Classification: Confusion Matrix, AUC /ROC Curve, F1 Score, Accuracy, Precision, Recall

***Note**: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to AI	06	04	04	-	08
II	Problem Solving	10	04	06	06	16
III	Knowledge and Reasoning	10	02	04	06	12
IV	Introduction to ML	08	02	04	04	10
V	Types of Learning	08	02	06	06	14
VI	Classification & Regression	06	02	04	04	10
	Total	**48**	**16**	**28**	**26**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*
This specification table also provides a general guideline for teachers to frame internal end semester practical theory exam paper which students have to undertake.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Prepare journals based on practical performed inlaboratory.
b. Library/E-Booksurveyregardingassembly language programmingusedinComputer industries.
c. Prepare power point presentation for showing different types of Assembly language ProgrammingApplications.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. No. of practical's selection to be performed should cover all units.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop

the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practicals, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) studentengagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **8-Puzzle Problem Solving**-Each group will develop a program to perform following operations
   1. Using any Uninformed or informed search algorithm

b. 8-queen Problem in python-Each group will develop a program to perform following operations using Python libraries

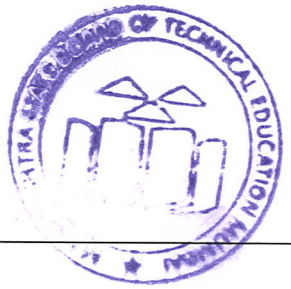
13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Artificial Intelligence A modern Approach Third edition	Stuart Russell and Peter Norvig, Editors	Pearson Education, Inc ISBN-13: 978-0-13-604259-4 ISBN-10: 0-13-604259-7
2	Machine Learning in Action	Peter Harrington,	DreamTech, First Edition, 2012 13: 978- 161729018
3	Practical Machine Learning with Python A Problem-Solver's Guide to Building Real-World Intelligent Systems	Dipanjan Sarkar Raghav Bali Tushar Sharma	Apress publication ISBN-13 (pbk): 978-1-4842-3206-4 ISBN-13 (electronic): 978-1-4842-3207-1
4	Introduction to Machine Learning with Python	Andreas C. Müller & Sarah Guido	O'Reilly Media, Inc
5	Machine Learning using Python	Manaramjan Pradhan, U Dinesh Kumar	Wiley india ISBN: 978-81-265-7990-7

14. SOFTWARE/LEARNING WEBSITES

a. https://www.pdfdrive.com/machine-learning-for-absolute-beginners-e188007429.html
b. https://www.geeksforgeeks.org/ml-fuzzy-clustering/
c. https://www.pdfdrive.com/machine-learning-step-by-step-guide-to-implement-machine-learning-algorithms-with-python-d158324853.html
d. https://machinelearningmastery.com/classification-as-conditional-probability-and-the-naive-bayes-algorithm/ (for Practical)
e. https://www.geeksforgeeks.org/naive-bayes-classifiers/ (for Practical)
f. https://favtutor.com/blogs/breadth-first-search-python (for BFS)
g. https://www.analyticsvidhya.com/blog/2021/10/an-introduction-to-problem-solving-using-search-algorithms-for-beginners/ (for practical 3 and 4)
h. https://www.geeksforgeeks.org/a-search-algorithm/?ref=lbp(for A*)

i. https://www.geeksforgeeks.org/uniform-cost-search-dijkstra-for-large-graphs/?ref=lbp (for Uniformed algorithms)
j. https://favtutor.com/blogs/depth-first-search-python (for DFS PR)
k. https://pub.towardsai.net/best-datasets-for-machine-learning-data-science-computer-vision-nlp-ai-c9541058cf4f (for data set)
l. https://www.educba.com/turing-test-in-ai/?source=leftnav (for Practical 9)
m. https://machinelearningmastery.com/machine-learning-in-python-step-by-step/ (for Practical 10)
n. https://www.geeksforgeeks.org/implementation-of-logistic-regression-from-scratch-using-python/?ref=rp (for logistic)
o. https://www.geeksforgeeks.org/ml-multiple-linear-regression-using-python/ (for Linear)



Program Name : **Diploma in Artificial Intelligence and Machine Learning**

Program Code : **AN**

Semester : **Fifth**

Course Title : **Cloud Computing for Data Science (Elective)**

Course Code : **22594**

1. RATIONALE

Cloud computing is one of the fastest growing domains. Cloud computing makes while allowing developers to build ML algorithms faster. Using cloud solutions for machine learning allow developers to build ML algorithms more accessible, flexible, and cost-effective. This course will cover the basic architecture of cloud environment, uses of various available cloud services to ease the machine learning process.

2. COMPETENCY

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

- **Use various cloud services for data science in machine learning.**

3. COURSE OUTCOMES (COs)

a. Identify the architecture and infrastructure of cloud computing
b. Classify various cloud service models
c. Explain cloud data warehouse functions
d. Describe data pipeline design in cloud environment
e. Demonstrate container for data validation
f. Demonstrate ML studio for model training

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(**) *marks should be awarded on the basis of internal end semester theoryexam of 50 marks based on the specification table given in S. No. 9.* ***(~[2]): For the practical only courses,*** *the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **ESE** -End Semester Examination; **PA** - Progressive Assessment, **'#':** No Theory Examination

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

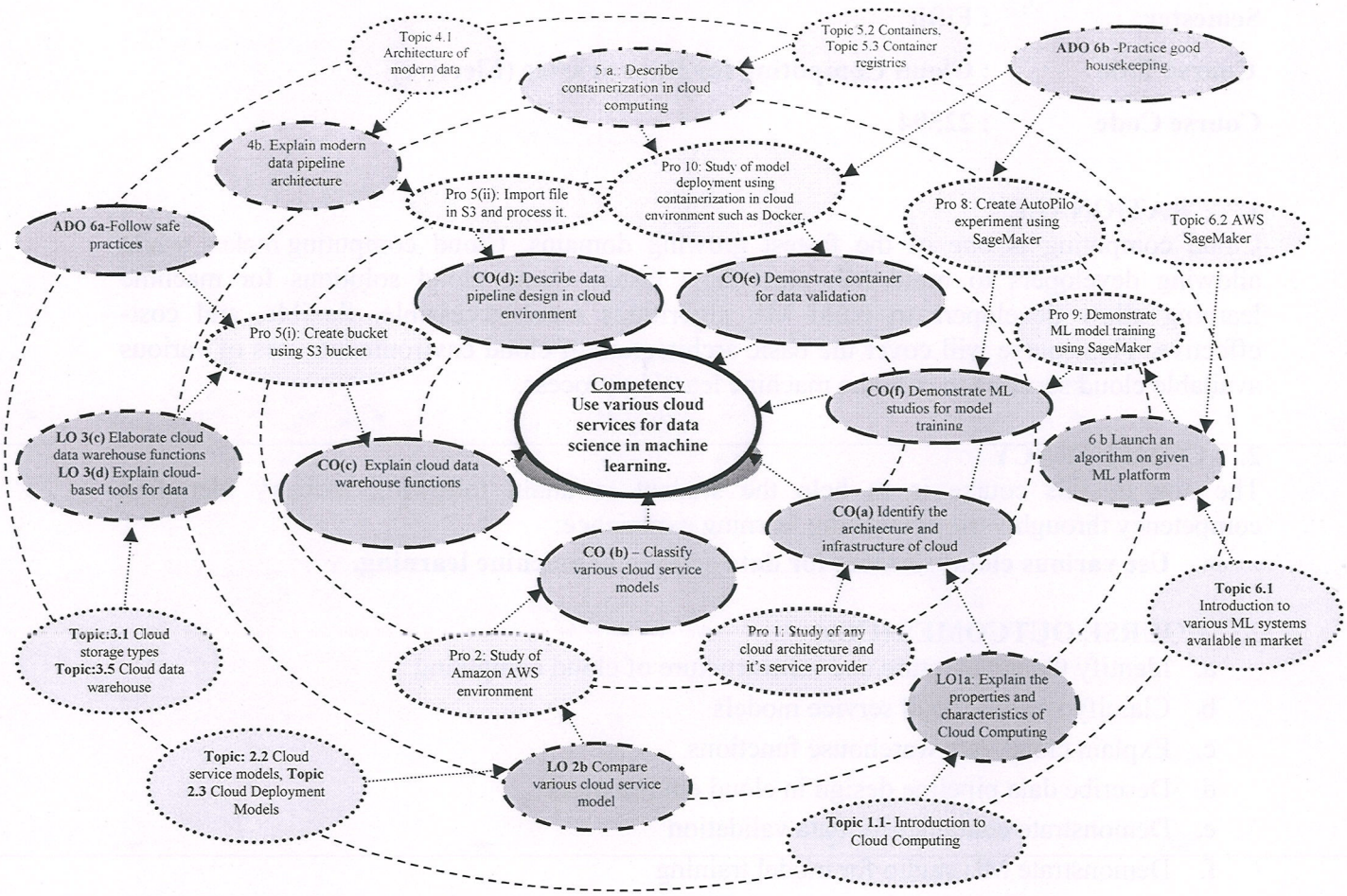


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e.sub-components of the COs) are to be developed andassessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
1	Study of any cloud architecture and it's service provider (with respect to front-end, back-end) such as Amazon AWS, Microsoft Azure, Google Cloud Platform (GCP) etc.	I	02
2	Study of Amazon AWS environment with respect to compute, storage, database, management tools, application services	I, II	02

S. No.	Practical Exercises (Learning Outcomes to be achieved through practicals)	Unit No.	Approx. Hrs. Required
3	(i) Create an AWS account with administrative role. (ii) Study of resource explorer in AWS	II	02
4	Create EC2 resources and launch the EC2 instance	III	02
5	(i) Create bucket using S3 bucket. (ii) Import file. Apply permissions to uploaded file. Perform processing such as authentication and authorization for selected file	IV	04
6	Prepare dataset using Data Wrangler. Process the created dataset using scikit-learn	III	04
7	(i) Create feature group and add features to the feature store (ii) Create dataset from features group	IV	04
8	Create Autopilot experiment using Amazon SageMaker Studio UI	VI	04
9	Demonstrate various training models on selected data set using SageMaker Autopilot	VI	04
10	Study of model deployment using containerization in cloud environment such as Docker.	V	04
	Total		**32**

'': compulsory practicals to be performed.*

Note

i. *Given in above tables is suggestive list of practical exercises. Teachers can design other similar exercises.*

ii. *Assessment of the 'Process' and 'Product' related skills in the laboratory/workshop/field work should be done as per suggested sample below:*

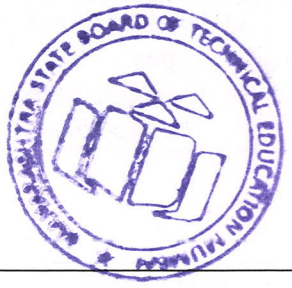
S.No.	Performance Indicators	Weightage in %
1	Preparation of experimental setup	30
2	Setting and Operation	20
3	Observation and Recording	20
4	Interpretation of result and conclusion	10
5	Answers to sample question	10
6	Submit Report in time	10
	Total	**100**

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above-mentioned laboratory/field-based experiences:

a. Handle command prompt environment.
b. Plan, develop, assemble, link, debug and test the programs.
c. Demonstrate working as a leader/a team member.

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

- 'Valuing Level' in 1st year
- 'Organizing Level' in 2nd year and
- 'Characterizing Level' in 3rd year.



7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Expt. S.No.
1	Computer System-Hardware: Personal computer, (i3 preferable) with min 8GB RAM, 512 GB HDD, Gigabit Ethernet network equipment, Software Requirement: Apache Tomcat, Java/Python/ equivalent programming language setup, Virtualization software. Academic version of any cloud service (AWS)	All

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopicsshouldbetaught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit - I Cloud Computing Fundamentals	1a. Explain the properties and characteristics of Cloud Computing 1b. Explain various layers and types of Cloud 1c. Identify the challenges and risks related to various aspects such as Security and Privacy 1d. Explain the evolution of cloud computing and virtualization	1.1. Introduction to Cloud Computing – Definition, Evolution of Cloud computing (from Mainframes to Clouds), Service – Oriented Architecture, Web Services, Grid Computing, Utility Computing, Hardware Virtualization. 1.2. Properties and Characteristics of a Cloud computing 1.3. Challenges and Risks: Security, Privacy, and Trust, Data Lock-In and Standardization, Availability, Fault-Tolerance, and Disaster Recovery, Resource Management and Energy-Efficiency. 1.4. Advantages of Cloud computing in Machine Learning
Unit - II Cloud Architecture and Cloud Service Management	2a. Explain the given component of cloud computing Architecture 2b. Compare various cloud service model 2c. Illustrate the services offered by various cloud computing models 2d. Compare various Cloud deployment models	2.1. Cloud computing architecture: basic components – front-end platform, back-end, platform, networking, cloud-based delivery 2.2. Cloud Service Models: - Software as a Service (SaaS), Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Continuous delivery using PaaS 2.3. Cloud Deployment Models: Public, Private, Community, Hybrid 2.4. Cloud service management – SLA, SLO, Policies and mechanisms for service management – admission control, load balancing, capacity allocation, energy optimization, QoS
Unit-III Cloud Data storage	3a. Explain cloud storage types 3b. Compare between storage types	3.1. Cloud storage types 3.2. Cloud data governance 3.3. Key-Value databases 3.4. Batch data and streaming data in

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	3c. Elaborate cloud data warehouse functions 3d. Explain cloud-based tools for data science	Machine learning 3.5. Cloud data warehouse – AWS Redshift 3.6. Various cloud-based tools used for data science in ML – GCP BigQuery,
Unit-IV Data Management using Cloud Computing	4a. Enlist data pipeline characteristics 4b. Explain Modern data pipeline architecture 4c. Describe ELT 4d. Describe data delivery in cloud computing	4.1 Architecture of Modern Data Pipelines 4.2 Data pipeline characteristics 4.3 Collecting and Ingesting Data 4.4 Transforming Data 4.5 Designing pipelines 4.6 Evolving from ETL to ELT 4.7 Delivering and sharing data
Unit – V Virtualization & Containerization & Elasticity in Cloud Computing	5a. Describe containerization in cloud computing 5b. Elaborate container registries 5c. Demonstrate model training pipeline in Kubernetes	5.1 Elastic Resources 5.2 Containers: Docker, Introduction to DevOps 5.3 Container Registries 5.4 Kubernetes in the Cloud – scaling, pipeline, microservices 5.5 Hybrid and Multi-cloud Kubernetes 5.6 Running Kubernetes locally with Docker Desktop and sklearn flask
Unit VI Managed Machine Learning Systems	6.a. Compare commercial and open-source ML systems 6.b. Launch an algorithm on given ML platform 6.c. Create log-in account and setup environment to train ML algorithm	6.1. Introduction to various ML systems available in market, Benefits of using managed ML platforms 6.2. Jupyter Notebook – Introduction, The workflow, 6.3. Azure ML Studio 6.4. Google AutoML Computer Vision 6.6. AWS SageMaker

Note: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Cloud Computing Fundamentals	8	6	6	-	12
II	Cloud Architecture and Cloud Service Management	8	2	6	4	12
III	Cloud Data storage	6	4	4	2	10
IV	Data Management using Cloud Computing	10	4	4	4	12
V	Virtualization & Containerization & Elasticity in Cloud Computing	10	4	4	6	14
VI	Managed Machine Learning Systems	6	2	4	4	10
	Total	**48**	**22**	**28**	**20**	**70**

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)
Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.
This specification table also provides a general guideline for teachers to frame internal end semester practical theory exam paper which students have to undertake.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Prepare journals based on practical performed inlaboratory.
b. Library/E-Booksurveyregardingassembly language programmingusedinComputer industries.
c. Prepare power point presentation for showing different types of Assembly language ProgrammingApplications.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. No. of practical's selection to be performed should cover all units.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry-oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practicals, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) studentengagement hours*** during the course.

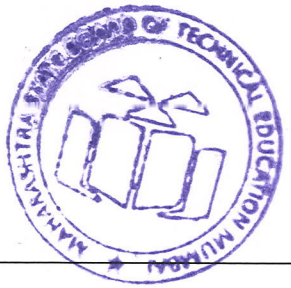
In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. Create an EC2 instance with specified resources and manage resources.
b. Create cloud storage on any given platform to upload dataset.
c. Create dataset for given problem statement. Also maintain dataset on the platform

d. Create / Use ML model through available platforms such as AWS SageMaker / Microsoft ML studio
e. Train ML model to perform given classification problems
f. Deploy ML algorithm to perform given task.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Cloud Computing: Principles and paradigm	Rajkumar Buyya	Wiley Publication
2	Machine Learning in the AWS Cloud	Abhishek Mishra	Sybex
3	Cloud Computing for Machine Learning and Cognitive Applications	Kai Hwang	The MIT Press (16 June 2017)
4	Cloud Data Engineering for dummies	David Baum	Jon Wiley & Sons, Inc.

14. SOFTWARE/LEARNING WEBSITES

Sr	Topic	Software / Website reference
1	Cloud computing architecture	www.nptel.ac.in
2	AWS service: EC2, S3	https://docs.aws.amazon.com/ec2/index.html?nc2=h_ql_doc_ec2
3	AWS S3 bucket user	https://docs.aws.amazon.com/pdfs/AmazonS3/latest/userguide/s3-userguide.pdf
4	AWS services	https://aws.amazon.com/getting-started/?nc2=h_ql_le
5	Importance of cloud computing for data science	• https://www.quora.com/How-important-is-cloud-computing-for-a-data-engineer • https://towardsdatascience.com/aws-essentials-for-data-science-why-cloud-computing-141cc6cee284
6	Course for data engineering using cloud computing	https://www.coursera.org/learn/cloud-data-engineering-duke
7	ML model creation and evaluation	https://scikit-learn.org/stable/modules/model_evaluation.html
8	Cloud computing for machine learning	https://www.javatpoint.com/machine-learning-and-cloud-computing
9	Introduction to AWS SageMaker	https://youtu.be/AVNqdT5ilOg
10	AWS Feature store	https://aws.amazon.com/blogs/machine-learning/automate-feature-engineering-pipelines-with-amazon-sagemaker/