AICTE workshop on Examination Reforms

Kerala State Date: 7-Dec-2018

Handout-A

Program Outcomes -Competencies – Performance Indicators

Following table gives the suggestive list of competencies and associated performance indicators for each of the PO in Mechanical Engineering Program.

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.	
Competency	**Indicators**
1.1 Demonstrate competence in mathematical modelling	1.1.1 Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems 1.1.2 Apply advanced mathematical techniques to model and solve mechanical engineering problems
1.2 Demonstrate competence in basic sciences	1.2.1 Apply laws of natural science to an engineering problem
1.3 Demonstrate competence in engineering fundamentals	1.3.1 Apply fundamental engineering concepts to solve engineering problems
1.4 Demonstrate competence in specialized engineering knowledge to the program	1.4.1 Apply Mechanical engineering concepts to solve engineering problems.
PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	
Competency	**Indicators**
2.1 Demonstrate an ability to identify and formulate complex engineering problem	2.1.1 Articulate problem statements and identify objectives 2.1.2 Identify engineering systems, variables, and parameters to solve the problems 2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2 Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1 Reframe complex problems into interconnected sub-problems 2.2.2 Identify, assemble and evaluate information and resources. 2.2.3 Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions 2.2.4 Compare and contrast alternative solution processes to select the best

		process.
2.3 Demonstrate an ability to formulate and interpret a model	2.3.1	Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.
	2.3.2	Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.
2.4 Demonstrate an ability to execute a solution process and analyze results	2.4.1	Apply engineering mathematics and computations to solve mathematical models
	2.4.2	Produce and validate results through skilful use of contemporary engineering tools and models
	2.4.3	Identify sources of error in the solution process, and limitations of the solution.
	2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

PO 3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

Competency		Indicators
3.1 Demonstrate an ability to define a complex / open-ended problem in engineering terms	3.1.1	Recognize that need analysis is key to good problem definition
	3.1.2	Elicit and document, engineering requirements from stakeholders
	3.1.3	Synthesize engineering requirements from a review of the state-of-the-art
	3.1.4	Extract engineering requirements from relevant engineering Codes and Standards such as ASME, ASTM, BIS, ISO and ASHRAE.
	3.1.5	Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues
	3.1.6	Determine design objectives, functional requirements and arrive at specifications
3.2 Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions
	3.2.2	Build models/prototypes to develop diverse set of design solutions
	3.2.3	Identify suitable criteria for evaluation of alternate design solutions
3.3 Demonstrate an ability to select optimal design scheme for further development	3.3.1	Apply formal decision making tools to select optimal engineering design solutions for further development
	3.3.2	Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.4 Demonstrate an ability to advance an engineering design to defined end state	3.4.1	Refine a conceptual design into a detailed design within the existing constraints (of the resources)
	3.4.2	Generate information through appropriate tests to improve or revise design

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Competency	Indicators
4.1 Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.1.1 Define a problem, its scope and importance for purposes of investigation 4.1.2 Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation 4.1.3 Apply appropriate instrumentation and/or software tools to make measurements of physical quantities 4.1.4 Establish a relationship between measured data and underlying physical principles.
4.2 Demonstrate an ability to design experiments to solve open ended problems	4.2.1 Design and develop experimental approach, specify appropriate equipment and procedures 4.2.2 Understand the importance of statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
4.3 Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1 Use appropriate procedures, tools and techniques to conduct experiments and collect data 4.3.2 Analyze data for trends and correlations, stating possible errors and limitations 4.3.3 Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions 4.3.4 Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Competency	Indicators
5.1 Demonstrate an ability to identify / create modern engineering tools, techniques and resources	5.1.1 Identify modern engineering tools such as computer aided drafting, modeling and analysis; techniques and resources for engineering activities 5.1.2 Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2 Demonstrate an ability to select and apply discipline specific tools, techniques and resources	5.2.1 Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs. 5.2.2 Demonstrate proficiency in using discipline specific tools
5.3 Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.3.1 Discuss limitations and validate tools, techniques and resources 5.3.2 Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Competency	Indicators

6.1 Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1 Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level
6.2 Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1 Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Competency	Indicators
7.1 Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1 Identify risks/impacts in the life-cycle of an engineering product or activity 7.1.2 Understand the relationship between the technical, socio economic and environmental dimensions of sustainability
7.2 Demonstrate an ability to apply principles of sustainable design and development	7.2.1 Describe management techniques for sustainable development 7.2.2 Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Competency	Indicators
8.1 Demonstrate an ability to recognize ethical dilemmas	8.1.1 Identify situations of unethical professional conduct and propose ethical alternatives
8.2 Demonstrate an ability to apply the Code of Ethics	8.2.1 Identify tenets of the ASME professional code of ethics 8.2.2 Examine and apply moral & ethical principles to known case studies

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Competency	Indicators
9.1 Demonstrate an ability to form a team and define a role for each member	9.1.1 Recognize a variety of working and learning preferences; appreciate the value of diversity on a team 9.1.2 Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2 Demonstrate effective individual and team operations--communication, problem solving, conflict resolution and leadership skills	9.2.1 Demonstrate effective communication, problem solving, conflict resolution and leadership skills 9.2.2 Treat other team members respectfully 9.2.3 Listen to other members Maintain composure in difficult situations

9.3 Demonstrate success in a team-based project	9.3.1 Present results as a team, with smooth integration of contributions from all individual efforts

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

Competency	Indicators
10.1 Demonstrate an ability to comprehend technical literature and document project work	10.1.1 Read, understand and interpret technical and non-technical information 10.1.2 Produce clear, well-constructed, and well-supported written engineering documents 10.1.3 Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
10.2 Demonstrate competence in listening, speaking, and presentation	10.2.1 Listen to and comprehend information, instructions, and viewpoints of others 10.2.2 Deliver effective oral presentations to technical and non-technical audiences
10.3 Demonstrate the ability to integrate different modes of communication	10.3.1 Create engineering-standard figures, reports and drawings to complement writing and presentations 10.3.2 Use a variety of media effectively to convey a message in a document or a presentation

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Competency	Indicators
11.1 Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1 Describe various economic and financial costs/benefits of an engineering activity 11.1.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2 Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1 Analyze and select the most appropriate proposal based on economic and financial considerations.
11.3 Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. 11.3.2 Use project management tools to schedule an engineering project so it is completed on time and on budget.

PO 12: Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	
Competency	**Indicators**
12.1 Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1 Describe the rationale for requirement for continuing professional development 12.1.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.2 Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current 12.2.2 Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
12.3 Demonstrate an ability to identify and access sources for new information	12.3.1 Source and comprehend technical literature and other credible sources of information 12.3.2 Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

The above table can be used for most of the engineering programs. However, for Computer Science / Information Science programs it requires some modifications.

Suggestive list of competencies and associated performance indicators for Computer Science / Information Science Programs are given in Appendix- A

AICTE workshop on Examination Reforms

Andhra Pradesh and Telangana States Date: 14-Dec-2018

Handout-A-2

Computer Science and Engineering

Program Outcomes -Competencies – Performance Indicators

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.	
Competency	**Indicators**
1.1 Demonstrate competence in mathematical modelling	1.1.1 Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems 1.1.2 Apply the concepts of probability, statistics and queuing theory in modeling of computer based system, data and network protocols.
1.2 Demonstrate competence in basic sciences	1.2.1 Apply laws of natural science to an engineering problem
1.3 Demonstrate competence in engineering fundamentals	1.3.1 Apply engineering fundamentals
1.4 Demonstrate competence in specialized engineering knowledge to the program	1.4.1 Apply theory and principles of computer science engineering to solve an engineering problem
PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	
Competency	**Indicators**
2.1 Demonstrate an ability to identify and formulate complex engineering problem	2.1.1 Evaluate problem statements and identifies objectives 2.1.2 Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem 2.1.3 Identifies mathematical algorithmic knowledge that applies to a given problem

2.2 Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1	Reframe the computer based system into interconnected subsystems
	2.2.2	Identifies functionalities and computing resources.
	2.2.3	Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions
	2.2.4	Compare and contrast alternative solution/methods to select the best methods
	2.2.5	Compare and contrast alternative solution processes to select the best process.
2.3 Demonstrate an ability to formulate and interpret a model	2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance.
	2.3.2	Identify design constraints for required performance criteria.
2.4 Demonstrate an ability to execute a solution process and analyze results	2.4.1	Applies engineering mathematics to implement the solution.
	2.4.2	Analyze and interpret the results using contemporary tools.
	2.4.3	Identify the limitations of the solution and sources/causes.
	2.4.4	Arrive at conclusions with respect to the objectives.

PO 3:Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

Competency	Indicators	
3.1 Demonstrate an ability to define a complex / open-ended problem in engineering terms	3.1.1	Able to define a precise problem statement with objectives and scope.
	3.1.2	Able to identify and document system requirements from stake holders.
	3.1.3	Ability to review state of the art literature to synthesize system requirements.
	3.1.4	Ability to choose appropriate quality attributes as defined by ISO/IEC/IEEE standard.
	3.1.5	Explore and synthesize system requirements from larger social and professional concerns.
	3.1.6	Ability to develop software requirement specifications (SRS).
3.2 Demonstrate an ability to	3.2.1	Ability to explore design alternatives.

	generate a diverse set of alternative design solutions	3.2.2	Ability to produce a variety of potential design solutions suited to meet functional requirements.
		3.2.3	Identify suitable nonfunctional requirements for evaluation of alternate design solutions.
3.3	Demonstrate an ability to select optimal design scheme for further development	3.3.1	Ability to perform systematic evaluation of the degree to which several design concepts meet the criteria.
		3.3.2	Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.4	Demonstrate an ability to advance an engineering design to defined end state	3.4.1	Ability to refine architecture design into a detailed design within the existing constraints.
		3.4.2	Ability to implement and integrate the modules.
		3.4.3	Ability to verify the functionalities and validate the design.
PO 4:Conductinvestigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.			
Competency		**Indicators**	
4.1	Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.1.1	Define a problem for purposes of investigation, its scope and importance
		4.1.2	Ability to choose appropriate procedure/algorithm, data set and test cases.
		4.1.3	Ability to choose appropriate hardware/software tools to conduct the experiment.
4.2	Demonstrate an ability to design experiments to solve open ended problems	4.2.1	Design and develop appropriate procedures/methodologies based on the study objectives
4.3	Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1	Use appropriate procedures, tools and techniques to collect and analyze data
		4.3.2	Critically analyze data for trends and correlations, stating possible errors and limitations
		4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
		4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions
PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools			

including prediction and modelling to complex engineering activities with an understanding of the limitations.

Competency	Indicators	
5.1 Demonstrate an ability to identify / create modern engineering tools, techniques and resources	5.1.1	Identify modern engineering tools, techniques and resources for engineering activities
	5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2 Demonstrate an ability to select and apply discipline specific tools, techniques and resources	5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
	5.2.2	Demonstrate proficiency in using discipline specific tools
5.3 Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.3.1	Discuss limitations and validate tools, techniques and resources
	5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Competency	Indicators	
6.1 Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at global, regional and local level
6.2 Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

PO 7:Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Competency	Indicators	
7.1 Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1	Identify risks/impacts in the life-cycle of an engineering product or activity
	7.1.2	Understand the relationship between the technical, socio economic and environmental dimensions of sustainability
7.2 Demonstrate an ability to apply principles of sustainable design and development	7.2.1	Describe management techniques for sustainable development
	7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline

PO 8:Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineenng practice.

Competency	Indicators	
8.1 Demonstrate an ability to recognize ethical dilemmas	8.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
8.2 Demonstrate an ability to apply the Code of Ethics	8.2.1	Identify tenets of the ASME professional code of ethics
	8.2.2	Examine and apply moral & ethical principles to known case studies

PO 9:Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Competency	Indicators	
9.1 Demonstrate an ability to form a team and define a role for each member	9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
	9.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2 Demonstrate effective individual and team operations--communication, problem solving, conflict resolution and leadership skills	9.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills
	9.2.2	Treat other team members respectfully
	9.2.3	Listen to other members
	Maintain composure in difficult situations	
9.3 Demonstrate success in a team-based project	9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

Competency	Indicators	
10.1 Demonstrate an ability to comprehend technical literature and document project work	10.1.1	Read, understand and interpret technical and non-technical information
	10.1.2	Produce clear, well-constructed, and well-supported written engineering documents
	10.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
10.2 Demonstrate competence in listening, speaking, and presentation	10.2.1	Listen to and comprehend information, instructions, and viewpoints of others
	10.2.2	Deliver effective oral presentations to technical and non-technical

	audiences
10.3 Demonstrate the ability to integrate different modes of communication	10.3.1 Create engineering-standard figures, reports and drawings to complement writing and presentations 10.3.2 Use a variety of media effectively to convey a message in a document or a presentation

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Competency	Indicators
11.1 Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1 Describe various economic and financial costs/benefits of an engineering activity 11.1.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2 Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1 Analyze and select the most appropriate proposal based on economic and financial considerations.
11.3 Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. 11.3.2 Use project management tools to schedule an engineering project so it is completed on time and on budget.

PO 12: Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Competency	Indicators
12.1 Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1 Describe the rationale for requirement for continuing professional development 12.1.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.2 Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current 12.2.2 Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field

12.3 Demonstrate an ability to identify and access sources for new information	12.3.1	Source and comprehend technical literature and other credible sources of information
	12.3.2	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

AICTE workshop on Examination Reforms

Kerala State Date: 7-Dec-2018

Handout-B

Blooms Taxonomy and

Suggestive Action Verbs for Assessment

Choice of action verbs in constructing assessment questions is important to consider. Quite often, the action verbs are indicators of the complexity (level) of the question. Over the time, educators have come up with taxonomy of measurable verbs corresponding to each of the Bloom's cognitive levels [8]. These verbs help us not only to describe and classify observable knowledge, skills and abilities but also to frame the examination or assignment questions that are appropriate to the level we are trying to assess.

A suggestive list of skills / competencies to be demonstrated at each of the Bloom's level and corresponding cues/ verbs for the examination / test questions are given below

Level	Skill Demonstrated	Question Ques / Verbs for tests
1. Remember	• Ability to recall of information like, facts, conventions, definitions, jargon, technical terms, classifications, categories, and criteria • ability to recall methodology and procedures, abstractions, principles, and theories in the field • knowledge of dates, events, places • mastery of subject matter	list, define, tell, describe, recite, recall, identify, show, label, tabulate, quote, name, who, when, where, etc.
2. Understand	• understanding information • grasp meaning • translate knowledge into new context • interpret facts, compare, contrast • order, group, infer causes • predict consequences	describe, explain, paraphrase, restate, associate, contrast, summarize, differentiate interpret, discuss

3. Apply	• use information • use methods, concepts, laws, theories in new situations • solve problems using required skills or knowledge • Demonstrating correct usage of a method or procedure	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, experiment, show, examine, modify
4. Analyse	• break down a complex problem into parts. • Identify the relationships and interaction between the different parts of complex problem. • identify the missing information, sometimes the redundant information and the contradictory information, if any.	classify, outline, break down, categorize, analyze, diagram, illustrate, infer, select
5. Evaluate	• compare and discriminate between ideas • assess value of theories, presentations • make choices based on reasoned argument • verify value of evidence • recognize subjectivity • use of definite criteria for judgments	assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate
6. Create	• use old ideas to create new ones • Combine parts to make (new) whole, • generalize from given facts • relate knowledge from several areas • predict; draw conclusions	design, formulate, build, invent, create, compose, generate, derive, modify, develop, integrate

It may be noted that some of the verbs in the above table are associated with multiple Bloom's Taxonomy level. These verbs are actions that could apply to different activities. We need to keep in mind that it's the skill, action or activity we need out students to demonstrate that will determine the contextual meaning of the verb used in the assessment question.

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Handout-C

Samples questions for Blooms taxonomy levels:

1. Remember

Skill Demonstrated	Question Ques / Verbs for tests
• Ability to recall of information like, facts, conventions, definitions, jargon, technical terms, classifications, categories, and criteria • ability to recall methodology and procedures, abstractions, principles, and theories in the field • knowledge of dates, events, places • mastery of subject matter	list, define, describe, state, recite, recall, identify, show, label, tabulate, quote, name, who, when, where, etc.

Sample Questions:

1. State Ohm's law
2. List the physical and chemical properties of silicon
3. List the components of A/D converter
4. List the arithmetic operators in increasing order of precedence.
5. Define the purpose of a constructor.
6. Define the terms: Sensible heat, Latent heat and Total heat of evaporation
7. List the assembler directives.
8. Describe the process of galvanisation and tinning
9. Write truth table and symbol of AND, OR, NOT, XNOR gates
10. Define the terms; Stress, Working stress and Factor of safety
11. **What is the difference between declaration and definition of a variable/function?**
12. **List the different storage class specifiers in C.**
13. **What is the use of local variables?**
14. What is a pointer on pointer?
15. What are the valid places for the keyword break to appear?
16. What is a self-referential structure?

2. Understand

Skill Demonstrated	Question Ques / Verbs for tests
• understanding information • grasp meaning • translate knowledge into new context • interpret facts, compare, contrast • order, group, infer causes • predict consequences	describe, explain, paraphrase, restate, associate, contrast, summarize, differentiate interpret, discuss

Sample Questions:

1. Explain the importance of sustainability in Engineering design
2. Explain the behaviour of PN junction diode under different bias conditions
3. Describe the characteristics of SCR and transistor equivalent for a SCR
4. Explain the terms; Particle, Rigid body and Deformable body giving two examples for each.
5. How many values of the variable num must be used to completely test all branches of the following code fragment ?

```
if (num>0)
        if (value<25)
    {
            value=10*num;
            if(num<12)
                value=value/10;
    }
    else
            Value=20*num;
else
            Value=30*num
```

6. Discuss the effect of Make in India initiative on the Indian manufacturing Industry.
7. Summarise the importance of ethical code of conduct for engineering professionals
8. Explain the syntax for 'for loop'.
9. What is the difference between including the header file with-in angular braces < > and double quotes " "?
10. What is the meaning of base address of the array?
11. What is the difference between actual and formal parameters?
12. Explain the different ways of passing parameters to the functions.
13. Explain the use of comma operator (,).
14. Differentiate between entry and exit controlled loops.
15. **How is an Array different from Linked List?**

3. Apply

Skill Demonstrated	Question Ques / Verbs for tests
• use information • use methods, concepts, laws, theories in new situations • solve problems using required skills or knowledge • Demonstrating correct usage of a method or procedure	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, experiment, show, examine, modify

Sample Questions:

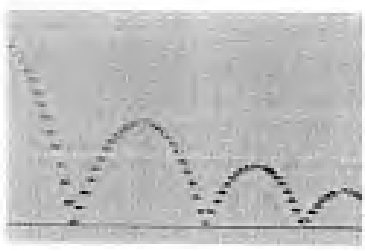
1. Model and realize the following behaviors using diodes with minimum number of digital inputs.
   (i) Turning on of a burglar alarm only during night time when the locker door is opened.
   (ii) Providing access to an account if either date of birth or registered mobile number or both are correct.
   (iii) Updating the parking slot empty light in the basement of a shopping mall.

2. One of the resource persons needs to address a huge crowd (nearly 400 members) in the auditorium. A system is to be designed in such a way that everybody attending the session should be able to hear properly and clearly without any disturbance. Identify the suitable circuit to boost the voice signal and explain its functionality in brief.

3. A ladder 5.0 m long rests on a horizontal ground & leans against a smooth vertical wall at an angle 20° with the vertical. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750 N stands on a rung 1.5 m from the bottom of the ladder. Calculate the coefficient of friction between the ladder & the floor.

4. A ball is dropped from 6 meters above a flat surface. Each time the ball hits the surface after falling a distance h, it rebounds a distance rh. What will be the total distance the ball travels in each of the following cases.

   (a) $r > 1$ (b) $0 < r < 1$ (c) $r = 1$



5. The region bounded by the curves $y = e^{-1/x}, y = 0, x = 1$, and $x = 5$ is rotated about the x-axis. Use Simpson's Rule with $n = 8$ to estimate the volume of the resulting solid.

Skill Demonstrated	Question Ques / Verbs for tests
• break down a complex problem into parts. • Identify the relationships and interaction between the different parts of complex problem	classify, outline, break down, categorize, analyse, diagram, illustrate, infer, select

6. An electric train is powered by machine which takes the supply from 220 V DC rail running above the train throughout. Machine draws current of 100 A from the DC rail to account for high torque during starting and runs at 700 r.p.m initially. Calculate the new speed of the train once it picks up the speed where the torque output required is only 70% of starting torque. Assume the motor has a resistance of 0.1Ω across its terminals.
7. Write an algorithm to implement a stack using queue.
8. A single array A[1..MAXSIZE] is used to implement two stacks. The two stacks grow from opposite ends of the array. Variables *top1* and *top2* (*top1*< *top2*) point to the location of the topmost element in each of the stacks. What is the condition for "stack full", if the space is to be used efficiently.
9. Consider the following table of arrival time and burst time for three processes P0, P1 and P2.

Process	Arrival time	Burst Time
P0	0 ms	9 ms
P1	1 ms	4 ms
P2	2 ms	9 ms

   The pre-emptive shortest job first scheduling algorithm is used. Scheduling is carried out only at arrival or completion of processes. What is the average waiting time for the three processes?
10. A CPU generates 32-bit virtual addresses. The page size is 4 KB. The processor has a translation look-aside buffer (TLB) which can hold a total of 128-page table entries and is 4-way set associative. What is the minimum size of the TLB tag?

4. Analyze

Sample Questions:

1. A class of 10 students consists of 5 males and 5 females. We intend to train a model based on their past scores to predict the future score. The average score of females is 60 whereas that of male is 80. The overall average of the class is 70. Give two ways of predicting the score and analyse them for fitting model.

2. Suppose that we want to select between two prediction models, M1 and M2. We have performed 10 rounds of 10-fold cross-validation on each model, whereas the same data partitioning in round one is used for both M1 and M2. The error rates obtained for M1 are 30.5, 32.2, 20.7, 20.6, 31.0, 41.0, 27.7, 26.0, 21.5, 26.0. The error rates for M2 are 22.4, 14.5, 22.4, 19.6, 20.7, 20.4, 22.1, 19.4, 16.2, 35.0. Comment on whether one model is significantly better than the other considering a significance level of 1%.

3. Return statement can only be used to return a single value. Can multiple values be returned from a function? Justify your answer.

Skill Demonstrated	Question Ques / Verbs for tests
• compare and discriminate between ideas • assess value of theories, presentations • make choices based on reasoned argument • verify value of evidence • recognize subjectivity • use of definite criteria for judgments	assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate

4. Bob wrote a program using functions to find sum of two numbers whereas Alex wrote the statements to find the sum of two numbers in the main() function only. Which of the two methods is efficient in execution and why?
5. Carly wants to store the details of students studying in 1st year and later on wishes to retrieve the information about the students who score the highest marks in each subject. Specify the scenario where the data can be organized as a single 2-D array or as multiple 1-D arrays.
6. Dave is working on a Campus Management Software but is unable to identify the maximum number of students per course. He decided to implement the same using arrays but discovered that there is memory wastage due to over provisioning. Which method of memory storage should be used by Dave and how it can be implemented using C?
7. Albert is working on a 32-bit machine whereas Julie is working on a 64-bit machine. Both wrote the same code to find factorial of a number but Albert is unable to find factorial of a number till 9 whereas Julie is able to find the factorial of higher number. Identify the possible reason why Albert is unable to find the factorial. Suggest some changes in the code so that Albert can handle bigger inputs.
8. While writing a C code, the problem faced by the programmers is to find if the parenthesis is balanced or not. Write an algorithm to check if the parenthesis in C code are balanced. Initially your code should work for balanced { and } braces.
9. Swapping of the data in a linked list can be performed by swapping the contents in the linked list. Can the contents of a linked list be swapped without actually swapping the data?

5. Evaluate

6. Create

• use old ideas to create new ones • Combine parts to make (new) whole, • generalize from given facts • relate knowledge from several areas • predict, draw conclusions	design, formulate, build, invent, create, compose, generate, derive, modify, develop, integrate

Both higher order cognitive skills 'Evaluate' and 'Create' are difficult to assess in time-limited examinations. These need to be assessed in variety of student works like projects, open ended problem-solving exercises etc. Typical examples of problem statements or need statements which need higher order abilities to solve are given below

Sample Problem / Need statements:

1. Automatic tethering of milking machine to the udder of a cow. A milk diary wants to automate the milking process. The milking process involves attaching the milking cups to the teats. Design a system for the same.
2. An electric vehicle uses LIoN batteries. The batteries have to be charged and get discharged during use. The batteries require continuous monitoring during charging and discharging so that they remain healthy and yield a long life. Design a system to monitor and manage the health of the batteries.
3. A Biotech industry needs automation for filling its product into 20 ltr bottles. Design a system to meter the flow into the bottles so that each bottle has 20 ltr of the liquid. There will be more than one filling station and the system has to monitor all the filling stations as well as keep count of the total production on a daily basis.
4. Microwave Doppler radar with a range of 9m are available for motion detection. Design a surround view monitoring system for a 3 wheeler to detect human obstacles while the vehicle is in motion.
5. Design a system to assist the driver by using cameras to detect lane markers and pedestrians while the vehicle is in motion.
6. Develop a small size USB 2.0 / 3.0 CMOS camera system which can be used for industrial inspection, medical applications, microscopy, etc. The system should be able to capture the image quickly and be able to process the captured image and then store it also

AICTE workshop on Examination Reforms

Kerala State Date: 7-Dec-2018

Handout-D

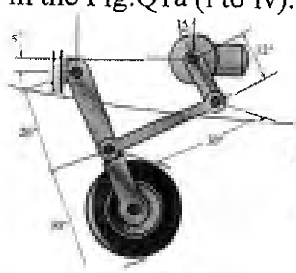
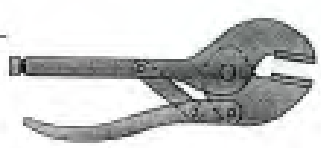
Course Name: Machines & Mechanisms

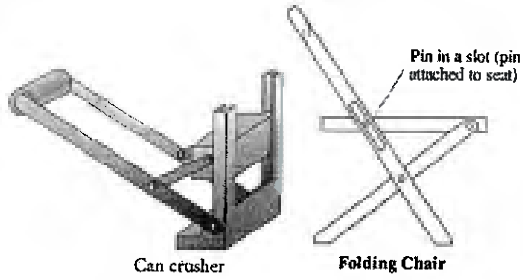
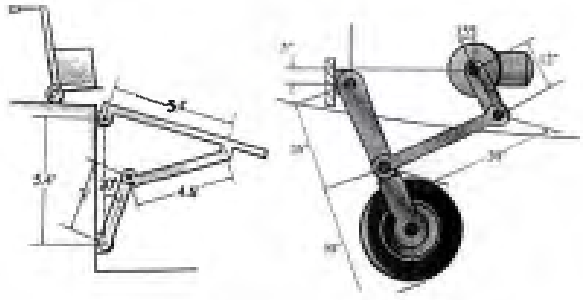
Course Outcomes (CO):

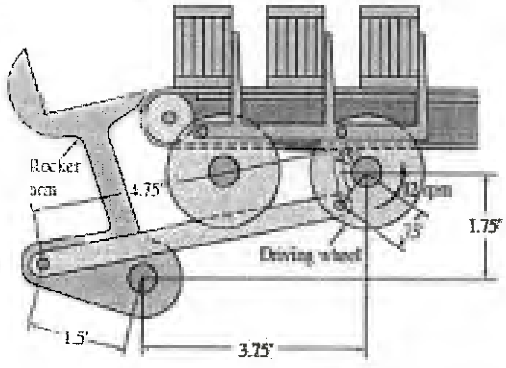
1. Analyze the given machine/mechanism for their type and mobility
2. Determine the velocity and acceleration of links in the mechanism using graphical and analytical methods.
3. Carry out the static and dynamic force analysis for a given mechanism.
4. Formulate the equations for kinematic and dynamic analysis of gear and gear trains for a given gear arrangement.
5. Analyze the dynamic forces and couples on rotating and reciprocating components of machines to compute the magnitude and direction of balancing mass.
6. Develop a cam profile for a given follower motions.
7. Ascertain the gyroscopic and centrifugal couple for a given application

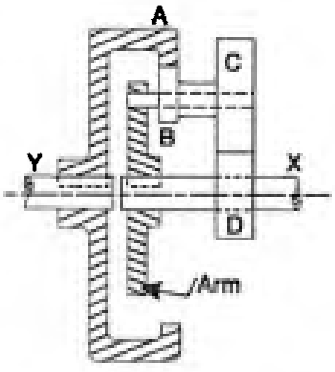
Model Question Paper
Total Duration (H:M): 3:00
Course: Machines & Mechanisms (15EMEC204)
Maximum Mark: 100

Note: *i) Answer any two full questions for Unit-1, any twa full questions from Unit-II and any one full question from Unit-III*

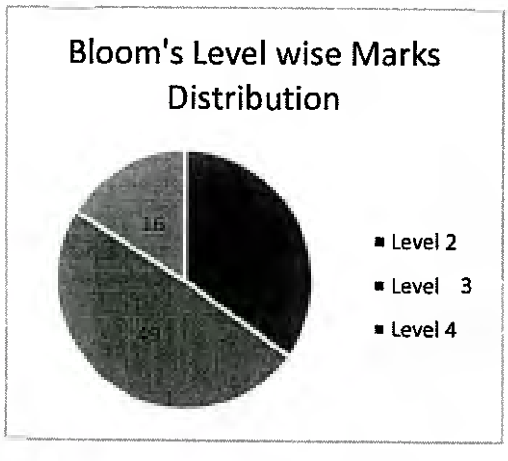
Q.No.	Questions	Marks	CO	BL	PI
	Unit 1				
1a)	Draw the kinematic diagram for the mechanisms shown in the Fig.Q1a (i to iv). Compute the mobility.  Landing gear  Vise grips	10	CO1	L3	2.1.2

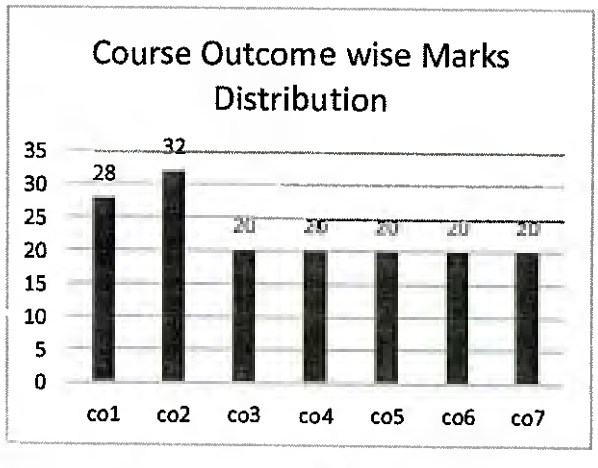
	 Fig.Q1a (i to iv)				
1b)	For the mechanisms shown in the Fig. Q1b i) and ii), locate all the instantaneous centers.  Fig Q1b.i) Self-locking brace Fig Q1b.ii) Landing gear	10	CO2	L2	2.1.3
2a)	Three links in a kinematic chain move relatively to each other. Prove that they have three instantaneous centers and lie in a straight line	8	CO2	L2	1.3.1
2b)	The gearbox shaft and propeller shaft of an automobile are connected by a universal joint. Obtain the expression for ratio of output shaft speed to input shaft speed. analyze the conditions when propeller shaft will have i) maximum speed ii) minimum speed and iii) both shafts have equal speeds.	12	CO1	L3	1.3.1
3a)	Describe with neat sketch the mechanism used in the automobile steering system and obtain the expression for condition of correct steering.	6	CO1	L2	1.3.1
3b)	The mechanism shown in the Fig. Q3b) is used to feed cartons to a labeling machine and, at the same time, to prevent the stored cartons from moving down. At full speed, the driveshaft rotates clockwise with an angular velocity of 200 rpm. At the instant shown, determine the acceleration of the rocker arm that rotates and lowers the parts.	14	CO2	L4	2.1.3

	 Fig. Q 3b)				
	Unit 2				
4a)	A shaft has 3 disturbing masses in the single plane with radii of rotation r_1, r_2 and r_3 and angular positions θ_1, θ_2 and θ_3. Discuss how the system will be balanced by adding another balancing mass in the same plane.	8	CO5	L2	1.4.1
4b)	Determine the required input torque on the crank AB of the reciprocating engine mechanism for the static equilibrium when applied piston load is 1000 N. The lengths of crank AB and connecting rod BC are 100 mm and 300 mm respectively and crank has turned through 60° from I.D.C.	12	CO3	L3	2.4.1
5a)	Explain with neat sketch i) equilibrium of two force member ii) equilibrium of three force member iii) member with two forces and applied torque.	8	CO3	L2	1.2.1

5b)	An over drive for a vehicle consists of an epicyclic gear train, as shown in Fig. Q5b), with compound planets B-C. B has 15 teeth and meshes with an annulus A which has 60 teeth. The planet C has 20 teeth and meshes with the sun wheel D which is fixed. The annulus is keyed to the propeller shaft Y which rotates at 740 rad/s. The spider which carries the pins upon which the planets revolve, is driven directly from main gear box by shaft X, this shaft being relatively free to rotate with respect to wheel D. Find the speed of shaft X, when all the teeth have the same module. When the engine develops 130 kW, what is the holding torque on the wheel D? Assume 100 per cent efficiency throughout.  Fig Q 5b) Epicyclic gear train	12	CO4	L4	2.1.3
6a)	The pinion on the lay shaft drives gear on the main shaft of automobile gear box. The contact between pair of in volute teeth begins at one point and ends at other point. Obtain an expression for path of contact between pair of involute teeth.	8	CO4	L3	1.3.1
6b)	The A, B, C & D are four masses carried by a rotating shaft at radius100, 125, 200 & 150 mm respectively. The planes in which masses revolve are spaced 600 mm apart & masses B, C & D are 10, 5 and 4 kg respectively. Find the required mass A & relative angular positions of the four masses to keep the shaft in the dynamic balance.	12	CO5	L3	2.4.1
	Unit 3				
7a)	In a single cylinder automotive engine spherical follower is operated by a disc cam. If the follower moves with simple harmonic motion then obtain an expression for velocity and acceleration during its out and return strokes.	8	CO6	L2	1.3.1

7b)	Design a cam to raise a valve with simple harmonic motion through 50 mm in 1/3 of a revolution, keep if fully raised through 1/12 revolution and to lower it with harmonic motion in 1/6 revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20 mm and the minimum radius of the cam is 25 mm. The diameter of the camshaft is 25 mm. The axis of the valve rod passes through the axis of the camshaft. If the camshaft rotates at uniform speed of 100 rpm, find the maximum velocity and acceleration of a valve during raising and lowering.	12	CO6	L3	2.1.2
8a)	Discuss with a neat sketch the axis of spin, axis of couple, axis of precession and precessional angular motion by considering the disc is spinning about X-axis. Obtain the expression for precessional angular motion.	8	CO7	L2	1.2.1
8b)	The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 rpm clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: i) when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h ii) when the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.	12	CO7	L3	1.2.1





BL – Bloom's Taxonomy Levels (1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)

CO – Course Outcomes

PO – Program Outcomes; PI Code – Performance Indicator Code

Course Name: Advanced Project Management

Course Outcomes (CO):

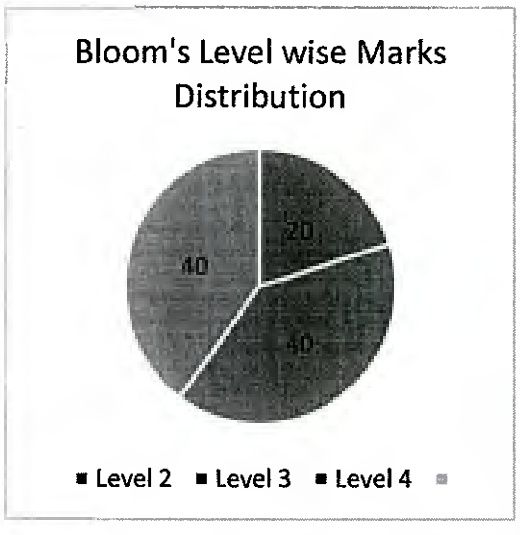
1. Assess the importance of monitoring and control phase during the execution of a construction project.
2. Combine estimating and scheduling and develop a cost loaded schedule which will combine both cost and time aspects into one cost loaded schedule.
3. Develop earned value reports to know the progress of the project at any instant of the project duration.
4. Evaluate the various bidding strategies employed in construction.
5. Conduct risk analysis to determine the probable risks involved and place appropriate mitigation measures in place.

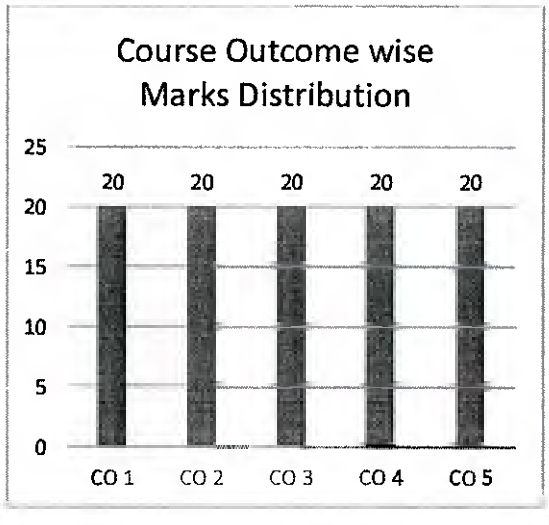
Model Question Paper
Total Duration (H:M): 3:00
Course: Advanced Project management
Maximum Marks :100

<table>
<tr><th>Q.No</th><th>Questions</th><th>Marks</th><th>CO</th><th>BL</th><th>PI</th></tr>
<tr><td>1</td><td>The following is the planned crew and quantity for the excavation activity. The scheduled work days is 6 days. The planned quantity is 3000 Cubic meters. Determine the planned total cost and unit cost for this activity.
<table>
<tr><th>Labor Force Required</th><th>Total Number</th><th>Per Day Rates</th></tr>
<tr><td>Back Hoes</td><td>07</td><td>₹ 1000/day</td></tr>
<tr><td>Operators</td><td>07</td><td>₹ 550/day</td></tr>
<tr><td>Dump Trucks</td><td>10</td><td>₹ 600/day</td></tr>
<tr><td>Dump Truck Drivers</td><td>10</td><td>₹ 350/day</td></tr>
</table>
After 3 days, the following is the report generated from the site.
Amount of work done: 1200 cubic meters. The crew worked for 8 hours/day for all the 3 days. Determine the cost that was spent for these 3 days. Comment on the productivity of the crew. Calculate the cost required to complete the work in the remaining 3 days. Analyze the given situation and determine whether additional crew is a better option compared to over-time for the existing crew.</td><td>20</td><td>CO1</td><td>L4</td><td>2.2.1</td></tr>
</table>

<table>
<tr><th>Q.No</th><th>Questions</th><th>Marks</th><th>CO</th><th>BL</th><th>PI</th></tr>
<tr><td>2</td><td>A typical small house construction project consists of the following operations along with the time set for its completion.
<table>
<tr><th>Operation (Activities)</th><th>Time (in days)</th><th>Cost (in Rupees)</th></tr>
<tr><td>Survey, design and Layout</td><td>6</td><td>10000</td></tr>
<tr><td>Construction of foundation</td><td>5</td><td>26000</td></tr>
<tr><td>Construction of Superstructure</td><td>11</td><td>80000</td></tr>
<tr><td>Roofing</td><td>5</td><td>34000</td></tr>
<tr><td>Fixing door and window frames</td><td>3</td><td>16000</td></tr>
<tr><td>Plumbing and Drainage</td><td>4</td><td>12000</td></tr>
<tr><td>Electric Fitting</td><td>4</td><td>19000</td></tr>
<tr><td>Plastering</td><td>4</td><td>7000</td></tr>
<tr><td>Flooring</td><td>4</td><td>32000</td></tr>
<tr><td>Carpentry work</td><td>2</td><td>10000</td></tr>
<tr><td>Painting</td><td>3</td><td>8000</td></tr>
</table>
The project starts on Monday 16th November 2018. Assume 5 days-work week. The following data was collected from the job site.
<table>
<tr><th>Operation</th><th>Percentage Complete</th><th>Actual Cost (in Rupees)</th></tr>
<tr><td>Survey, design and Layout</td><td>100 %</td><td>11600</td></tr>
<tr><td>Construction of foundation</td><td>100 %</td><td>25200</td></tr>
<tr><td>Construction of Superstructure</td><td>80 %</td><td>76000</td></tr>
<tr><td>Roofing</td><td>25 %</td><td>12000</td></tr>
</table>
At present the data date is Friday, 11-12-2018.
i. Determine the total duration of the project. State any assumptions you make.
ii. Compile PV (Planned Value), EV (Earned Value) and AC (Actual Cost) from the data provided.
iii. Analyze the status of the project (using EVA) and create a status report. Comment on the forecast of the project.</td><td>20</td><td>CO2</td><td>L4</td><td>13.1.3</td></tr>
<tr><td>3a</td><td>A project consists of 8 activities from A to F. The following is the progress report sent to you from the field after 2 months. The project was planned to</td><td>20</td><td>CO3</td><td>L3</td><td>11.3.1</td></tr>
</table>

<table>
<tr><th>Q.No</th><th>Questions</th><th>Marks</th><th>CO</th><th>BL</th><th>PI</th></tr>
<tr><td></td><td>be completed till activity D after 2 months. Analyse the project. Also comment on the status of each individual activity in terms of profit/loss.
<table>
<tr><th>S. No.</th><th>Activity</th><th>Planned Value</th><th>Actual Cost</th><th>Percentage Complete</th></tr>
<tr><td>1</td><td>A</td><td>10000</td><td>9500</td><td>100%</td></tr>
<tr><td>2</td><td>B</td><td>25000</td><td>26300</td><td>100%</td></tr>
<tr><td>3</td><td>C</td><td>32000</td><td>35000</td><td>96%</td></tr>
<tr><td>4</td><td>D</td><td>28000</td><td>17000</td><td>72%</td></tr>
<tr><td>5</td><td>E</td><td>56000</td><td>30000</td><td>46%</td></tr>
<tr><td>6</td><td>F</td><td>87000</td><td>24000</td><td>34%</td></tr>
<tr><td>7</td><td>G</td><td>96000</td><td></td><td></td></tr>
<tr><td>8</td><td>H</td><td>68000</td><td></td><td></td></tr>
</table></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4a</td><td>There is a call for tender for construction of stadium in your city, only few reputed private construction companies have been asked to participate in the tender by the governing body, your company is one of them. Your boss asks you to prepare the necessary document which is required for the tendering work for the construction of stadium.</td><td>12</td><td>CO4</td><td>L2</td><td>11.3.1</td></tr>
<tr><td>4b</td><td>Discuss the different type of bidding models</td><td>08</td><td>CO4</td><td>L2</td><td>1.3.1</td></tr>
<tr><td>5</td><td>Your company has just won a bid to construct an electrical sub-station over 5 acres of land which is covered with vegetation. The major activities of the project are site clearance, surveying, subgrade base, piers and bolts, control room, asphalt base, painting and clean-up. Evaluate the project and list all risks that could occur on this project. List the mitigation techniques to be placed to counter the identified risks.</td><td>20</td><td>CO5</td><td>L3</td><td>2.1.1</td></tr>
</table>





BL – **Bloom's Taxonomy Levels (1- Rem**embering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)

CO – Course Outcomes

PO – Program Outcomes; PI Code – Performance Indicator Code

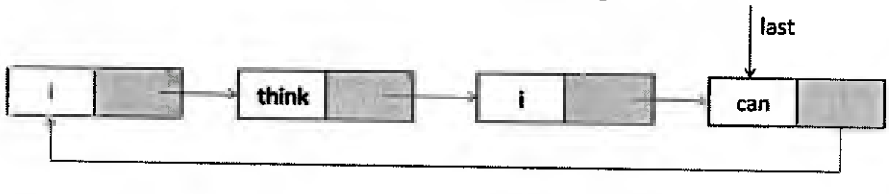
30

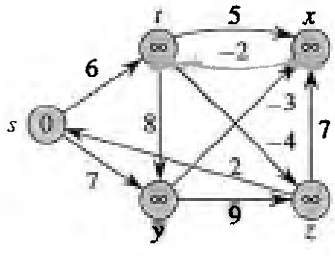
Course Name: Data Structures and Algorithms

Course Outcomes (CO):

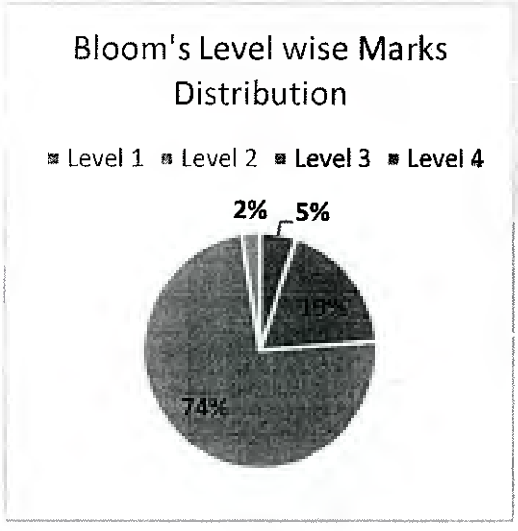
1. Discuss the C language features and analyze the differences between recursive and iterative programming structures
2. Analyze the role of data structures in structuring and manipulating data and implement them using array or list representation
3. Discuss the properties, operations, applications, strengths and weaknesses of the different data structures and their effect on algorithms
4. Analyze, interpret and compare various sorting, searching and graph algorithms and perform efficiency analysis
5. Discuss the file structures and storage management for efficient access of data

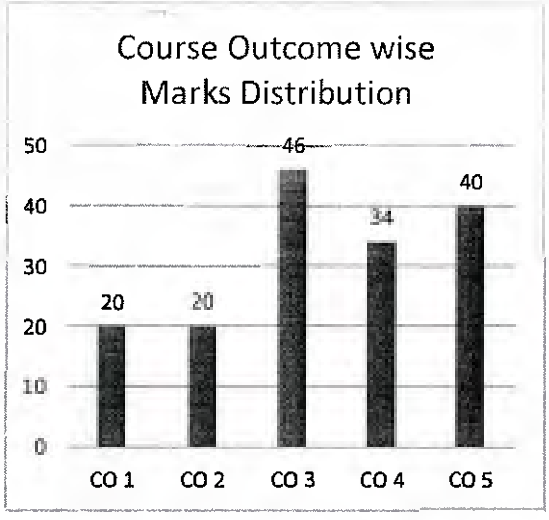
Model Question Paper
Total Duration (H:M): 3:00
Course: Data Structures and Algorithms
Maximum Marks: 100

Q.No	Questions	Marks	CO	BL	PI
1(a)	Suppose we wish to search a linked list of length n, where each element contains a key k long with a hash function h(k). Each key is a long character string. How might we take advantage of the hash values when searching the list for an element with a given key?	4	CO3	L3	1.4.1
1(b)	With the help of suitable code snippets, Prove That: "Queue is NO more exactly a First In First Out data structure"	6	CO2	L2	1.4.1
1(c)	Using state space tree prove that: • There is no solution for a 2 queen problem • There are multiple solutions for a 4 queen problem	10	CO1	L2	1.4.1
2(a)	Differentiate between Structures and Unions with suitable code snippets.	4	CO1	L3	1.4.1
2(b)	A linear probing has a hash function of the form: h(k, i) = (h'(k) + i) mod m and a quadratic probing has a hash function of the form: h(k, i) = (h'(k) + c 1 i + c 2 i 2) mod m. Linear probing suffers from a problem known as primary clustering and quadratic probing from secondary clustering. Discuss.	6	CO3	L3	1.4.1
2(c)	Consider the circular list given below with string data:  Write a function which will display the output in following fashion: *i think i can* *think i can*	10	CO2	L3	1.4.1

Q.No	Questions	Marks	CO	BL	PI
	i can *can* At each line, the function should display data from all the nodes present. After printing each line, an appropriate node has to be deleted. After printing the last line, "last" pointer should be holding the NULL value.				
3(a)	Write a program to print the nth node from end from a singly linked list.	4	CO2	L3	1.4.1
3(b)	Complete the function described below: Function Name: summon Input Params: base address of string Return Type: base address of summoned string Description: A magician wants to generate summoning charms. For input string "firebolt", the function should produce "summon firebolt". Do not use any inbuilt string handling functions.	6	CO1	L3	1.4.1
3(c)	Write the modules to implement the following using Stack data structure: • Check if the given string is palindrome • Sort the given set of integers	10	CO3	L3	1.4.1
4(a)	You have been invited to a post-exam party. i) You walk in and shake everyone's hand. As the number of attendees N increases, what is the order of growth to shake everyone's hand? Justify. ii) You meet everyone else and during each meeting, you talk about everyone else in the room. To what efficiency class does this belong to? Justify.	4	CO3	L4	1.1.2
4(b)	Create a AVL Tree for: 50, 60, 80, 30, 20, 40, 70 Can you perform the three tree traversals on AVL tree? Justify your answer.	6	CO3	L3	1.4.1
4(c)	Apply Bellman-Ford Algorithm on the given graph.  How is Bellman-Ford different from Dijkstra's Algorithm? To what design technique does the algorithm belong to? Explain.	10	CO4	L3	1.4.1
5(a)	Bring out the differences between Prim's and Kruskal's algorithm. Also compare with respect to efficiency analysis.	4	CO4	L2	1.4.1
5(b)	Write a algorithm for given below description: ALGORITHM CountLeafNodes(T) // Recursively counts the number of leaf nodes in the tree T	6	CO3	L3	1.4.1

Q.No	Questions	Marks	CO	BL	PI
5(c)	Apply Quick Sort on the following: Q U I C K S O R T Write the efficiency analysis of quick sort (Best, Worst, and Average).	10	CO4	L3	1.1.2
6(a)	Write the algorithm design technique for the given below algorithms/problems: i) N-Queen's Problem ii) Binary Search iii) Insertion Sort iv) AVL Trees v) Heap Sort vi) Hashing vii) Boyer-Moore viii) Breadth First Search	4	CO4	L2	1.4.1
6(b)	A DNA sequence consists of a text on the alphabet {A, C, G, T} and the gene or gene segment is the pattern. For the pattern for chromosome-10: TCCTATTCTT construct the following tables: i) π- table ii) Bad Symbol Shift Table	6	CO4	L3	1.4.1
6(c)	Write a function to delete a node from a Binary Search Tree. Suitably comment the code explaining each of the cases.	10	CO3	L3	1.4.1
7(a)	What are indexed sequential files?	4	CO5	L1	1.4.1
7(b)	Explain fseek( ) API with help of a C suitable program. Explain each of the parameter it takes in detail.	6	CO5	L3	1.4.1
7(c)	A file consists of binary data. Write a program to read and count the number of 0's and 1's in it. Write the individual count in a separate file. Also find the size of the file.	10	CO5	L3	1.4.1
8(a)	What do you mean by storage release?	4	CO5	L1	1.4.1
8(b)	Differentiate between the fixed block and variable block storage management.	6	CO5	L2	1.4.1
8(c)	With a help of a suitable program explain the concept of Bit Maps and how they can be used as an efficient storage means.	10	CO5	L3	1.4.1





BL – Bloom's Taxonomy Levels (1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)
CO – Course Outcomes
PO – Program Outcomes; PI Code – Performance Indicator Code

Handout -E: Session-3

Mechanical

		Question	Marks	CO addressed	Blooms level	PI
1	a	Three links in a kinematic chain move relatively to each other. Prove that they have three instantaneous centres and lie in a straight line				
	b	The gearbox shaft and propeller shaft of an automobile are connected by a universal joint. Obtain the expression for ratio of output shaft speed to input shaft speed. analyze the conditions when propeller shaft will have i) maximum speed ii) minimum speed and iii) both shafts have equal speeds.				

Civil

		Question	Marks	CO addressed	Blooms level	PI
1	a	Enumerate the impurities in ground water which should be taken into account in deciding the potability of a sample. State the effects when they exceed the prescribed BIS limits.				
	b	For the water supply of a small town, water is required to be pumped from a tube well to an overhead tank. Work out the capacity of the pump. The data are given as below. Daily demand of water 750 m^3 Hours of pumping 8 Water table below ground level 8 m Height of the tank above ground level 14 m Loss of head in the pump and rising main 1.75 m				
	c					

Electronics

		Question	Marks	CO addressed	Blooms level	PI
1	a	With MAF sensor malfunctioning as detected by the engine control system diagnostic function, how engine control system can work effectively as possible with other existing sensor information for calculating the mass air flow rate.				
	b	Assume a vehicle is running at a fixed rpm of 8000 and further the driver demands for increase in speed. How the engine ECU handles driver's request using ignition timing? Suggest a suitable Instrumentation system with related electronics for closed loop control of ignition timing.				
	c	Vehicle is moving with a high speed; suddenly the driver applies the brakes, what is the physical consequence of this condition on wet and dry surface? Provide a suitable control system/electronic solution to avoid the damage.				

Computer Science

		Question	Marks	CO addressed	Blooms level	PI
1	a	A vending machine dispensing books of stamps accepts only one-dollar coins, \$1 bills, and \$5 bills. a) Find a recurrence relation for the number of ways to deposit n dollars in the vending machine, where the order in which the coins and bills are deposited matters. b) What are the initial conditions? c) How many ways are there to deposit \$10 for a book of stamps?				
	b	Solve these recurrence relations together with the initial conditions given. i. $a_n = 2a_{n-1}$ for $n \geq 1$, $a_0 = 3$ ii. $a_n = a_{n-1}$ for $n \geq 1$, $a_0 = 2$				
	c	a) Find a recurrence relation for the number of steps needed to solve the Tower of Hanoi puzzle. b) Show how this recurrence relation can be solved using iteration				