Government of Karnataka

PROGRAM SPECIALIZATION PATHWAY
CAPSTONE PROJECT GUIDELINES
FOR
COHORT OWNER, STUDENTS AND EXAMINERS

Department of Technical Education,
Palace Road, Bangalore 560001, Karnataka

CAPSTONE PROJECT

How to design and deliver

The students of Polytechnic Programs will have an opportunity to be part of one of the most challenging educational experiences in the year-3. The students will be trained in the specialization pathways of their interest through bootcamp mode in fifth semester followed by an internship or a capstone project work in sixth semester. Those students who want to do a capstone project, requires to do developmental work on real-world problems which would motivate them to produce practical solutions. It is an opportunity for the students to use the problem-solving tools and techniques to solve the problems while doing the capstone project. With this approach, the learning process is gained through 'by-doing' experience and the students are expected to apply both the Capstone project Management Skills and Technical Skills gained in previous years of polytechnic courses, which will enable them to participate and prepare for future employment.

Working under the guidance of a Cohort owner, students may shape the direction of what they want to be, as well as gain better understanding of the responsibilities they need to shoulder when they undertake a capstone project. Teamwork will be inculcated with the development of good and professional relationships with their cohort owner and team members. The undertaken capstone project can also be used as a basis for employment or Startup by fully exploiting the learning process they have gone through, the skills they have gathered and the experience they have gained from the capstone project.

The guidelines are prepared for Cohort owner, students and examiners enabling them to execute their respective roles and responsibilities in an effective manner.

Aims of Capstone

1. Promote integration and synthesis within the program of study.
2. Promote meaningful connections between the program of study and career experiences.
3. Improve learner's career preparation and pre professional developments.
4. Demonstrate professional identity as learner's transition from academic to professional World.

Job Alignment and Professional Scenario

While developing a capstone the goal should always to;

1. Use a real world professional scenario- built out with employer engagement where ever possible.
2. Align skills to be assessed to a job.
3. Explicitly and intentionally developed important learner's skills, competencies and perspectives that are tacitly developed in the curriculum and required in the workplace.
4. Give learner's the freedom to showcase their learning though a demonstrable artifact or output e.g. Technical Product, System, Service that resolves a real world problem.

Employer Engagement

Support in capstone development:

- Provide a problem statement
- Provide a case study background
- Review and feedback on case studies/scenarios developed

Support in class

- Mentor learner's during the capstone
- Support cohort owners during class-workshop seminars

Presentation of Capstone

- Sit on presentation panel for learner's to give feedback.

Outcomes

On successful completion of the capstone project, students will be able to:

- Write Capstone project scope document
- Prepare a capstone project execution plan
- Manage the capstone project from start to finish meeting stated milestones and timelines
- Test and validate the findings
- Demonstrate interpersonal skills, teamwork, and effective use of appropriate technology required for the capstone project

Responsibilities of the Head of the Department

The Head of the Department shall coordinate in Executing the Specialization Pathway Capstone projects, their responsibilities can be summarized as follows:

- To ensure that the Capstone project scope document is relevant to the specialization pathway opted by the students in Fifth semester
- To assign Cohort owner to the students
- To maintain a centralized capstone project hub repository to facilitate capstone project management and keeping track of all capstone projects and design changes

Responsibilities of the Cohort owner

Students will be supervised by Cohort owner; their responsibilities can be summarized as follows:

- To guide the students in writing the Capstone project scope document
- To guide the students in preparing capstone project execution plan
- To interact with the students once in a week to review the progress of the capstone project work, these sessions shall reinforce/review the concepts, findings and focus on addressing issues relevant to weekly meetings

- To guide the students in managing the capstone project from start to finish, meeting the stated milestones and timelines
- To guide the students in preparing the capstone project report
- Develop appropriate Rubrics and evaluate the capstone project work as per assessment criteria
- To oversee the capstone project work until the submission of the final report, and Semester End Examination
- Maintain all the documents related to the capstone project work

Responsibilities of the Students

Students are also required to exercise self-discipline, self-management, job co-ordination, teamwork, and trustworthiness to ensure the success of the capstone project.

The expected responsibilities are:

- To write the Capstone project scope document
- To prepare a capstone project execution plan
- To adhere to the weekly meeting schedule with the cohort owner for the purpose of updating their progress and seeking advice on capstone project matters (Attendance is compulsory as per regulation) and submit weekly report
- To Manage the capstone project from start to finish meeting stated milestones and timelines
- To report immediately to the cohort owner any difficulties encountered that would interrupt the work.
- To submit all reports on time

Group Member Roles and Contributions

The Capstone project groups often function more effectively when group members have designated roles. Each capstone project group shall consist of not more than **four students**. The Three core roles and responsibilities are:

- **Capstone project Lead**: One student in the group shall act as a capstone project lead, who is responsible for keeping the group on task, distributing the workload, meeting deadlines, and ensuring smooth group communication and coordination as well as accountability with the cohort owner and capstone project requirements
- **Documenter Lead**: One student in the group shall act as a documenter lead, who is responsible for recording group discussions and decisions, documenting various aspects of the capstone project's progress, and ensuring well-formed reports and capstone project documents are produced.
- **Development Lead**: Two students in the group shall act as a Development lead, who are responsible for overseeing the collaborative aspects of the capstone project, troubleshooting major technical problems.

The entire capstone project team should be engaged in discussions, documentation, and development of the capstone project. All members are expected to contribute towards the capstone project.
Groups will a have to rotate the roles among members for different stages of the capstone project. This will allow members to gain experience through being responsible in different areas of capstone project management.

Assessment of the capstone project work

This section is addressed to cohort owner and examiners. It provides information on assessment criteria for the capstone project work. It also provides guidance to students about what examiners will be looking for in evaluating the capstone projects. The Capstone project work will be assessed for 400 marks through formative and summative assessment tools, in formative assessment the capstone project will be evaluated for 240 marks and in summative assessment capstone project will be evaluated for 160 marks

The Formative Assessment- (Continuous Internal Evaluation- CIE)

The Formative Assessment is conducted for 240 marks throughout the course in three developmental phases as CIE-I, CIE II and CIE-III. Students shall complete CIE-I before taking CIE-II and complete CIE-II before taking CIE-III, otherwise they will not be eligible to take Semester End Examination

Continuous Internal Evaluation- CIE - I conducted at the end of 4th week		
Sl No	**Assessment of parameter**	**Marks**
1	Writing the Capstone project scope document	20
2	**Capstone project Planning**: • Work Breakdown Structure (WBS) - 10 marks • Time-line Schedule - 10 marks • Cost Breakdown Structure (CBS) - 10 marks • Risk Analysis - 10 marks	40
3	Identification of Methodology (Including Literature survey)	20
	Total	**80**

Continuous Internal Evaluation- CIE - II conducted at the end of 8th week		
Sl No	**Assessment of parameter**	**Marks**
1	**Capstone project Details:** • Description of Technology Used • Details of Hardware devices • Details of software products • Programming languages • Descriptions of the components in the system • Component diagrams and required design if any • Construction or Fabrication details • Any other information needed to execute the capstone project	80
	Total	**80**

Continuous Internal Evaluation- CIE - III conducted at the end of 12th week		
Sl No	**Assessment of Parameter**	**Marks**
1	**Testing and validation**: Details of laboratory experiments/programming/modelling/simulations/ analysis/fabrication/construction etc.,	50
2	Results and inference	30
	Total	**80**

The Summative assessment- Semester End Examination (SEE)

During the Summative assessment, students shall demonstrate the outcomes of their Capstone project work to the Panel of Examiners comprising a cohort owner and an external Subject expert

The evaluation criteria are as follows:

Sl No	Parameters	Marks
1	Power point presentation on outcomes of the Capstone project work	60
2	Demonstration the Capstone project work	60
3	Capstone project Report -Format and Technical writing skill	40
	Total	**160**

Plagiarism

Plagiarism is the act of obtaining or attempting to obtain credit for academic work by representing the work of another as one's own without the necessary and appropriate acknowledgment. If a student is in doubt of the nature of plagiarism, he/she should discuss the matter with the supervisor. If a student is caught committing plagiarism, disciplinary action will be taken against the student

Keeping in view the policy of plagiarism, and avoid piracy of intellectual property, the student needs to follow the citation policy:

- When 10 words are taken together from some established core work, citation becomes essential.
- When the copied content reaches 40 words in accumulation, the fragment needs to be kept under inverted comma ("_") in italic.
- It is necessarily required to cite reference in case of any content adopted from anywhere other than internet open sites. It is also that, even in case of open site internet source or any other source the copied contents if found more than 35 percent in aggregate during plagiarism detection, the work shall not be considered for further process and asked to resubmit the report again for the evaluation

Copyright

The Polytechnic institutions shall be the owner for all findings, designs, patents, and other intellectual property rights.

FORMATS

Department of Technical Education
Capstone project

Format- 1

Capstone project Scope Document

Capstone project Scope Document

The capstone project scope clearly describes what the capstone project will deliver and outlines all the workrequired for completing the capstone project.

Capstone project Title:

Group Members:

Problem Statement:

Objectives:

Capstone project description:

Capstone project Deliverables:

Key milestones:

Constraints:

Estimated Capstone project Duration:

Estimated Capstone project cost:

Date

Signature of the student

Signature of the cohort owner

Department of Technical Education
Capstone project

Format- 2

Work Breakdown Structure

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

Capstone project Objective(s): < statements describing the capstone project's objective(s)>

Work Breakdown Structure - Deliverables

1. Identify the deliverables (in the scope statement) to be produced in the capstone project.
   This highlights the work to be done.
2. Decompose each large deliverable into a hierarchy of smaller deliverables. This involves taking a deliverable and breaking it down into lower and lower levels of detail.
3. The lowest level of detail is called a 'work package' which consists of activities and tasks.

Date

Signature of the student

Signature of the cohort owner

Department of Technical Education
Capstone project

Format- 3
Time - line Schedule

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

1. Identify the activities and tasks needed to produce each work package.
2. Identify resources for each task (e.g., time, knowledge, monetary costs etc.)
3. Estimate how long it will take to complete each task. Consider constraints - resources,time, knowledge
4. Determine which tasks are dependent on other tasks and develop a critical path.
5. Develop a schedule of all activities and tasks - weekly and monthly. Work out when eachtask is scheduled to begin and end. Use a Gantt chart.

Date

Signature of the student

Signature of the cohort owner

Department of Technical Education
Capstone project

Format- 4
Cost Breakdown Structure

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

A cost breakdown structure (CBS) breaks down cost data into different categories, and helps you manage costs efficiently. It is a crucial part of the capstone project planning and management process, as it allows you to gain better insight into how much you spend and what you spend your capstone project budget on. When you have a solid structure in place, you can have better control of your capstone project costs to avoid going over budget.

1. **Analyze your Work Breakdown Structure**
   - Before you can identify your costs, you must first determine what your capstone project entails.
   - You can do this by looking at your work breakdown structure in detail, and work out the components that will contribute to the capstone project costs.
2. **Estimate the labor cost of work**
   - The next step is to estimate the labor cost of work for each task or activity you have identified in your WBS.
   - The time it takes for your team members to finish each work package in the WBS contribute to your labor costs.
   - Once you have estimated the labor costs of work for all the tasks, you can use them to work out the final cost of labor for your capstone project.
3. **Estimate the cost of materials**

The next step is to look at the cost of the materials needed to complete each task you identified in your WBS. These costs include

- Raw material costs
- Equipment and parts purchased for this capstone project
- Anything rented for the purpose of the capstone project

4. **Overhead costs.**
   - Ensure your CBS also includes an appropriate allocation to overhead costs.
   - Overhead include various costs that aren't related to specific tasks, but are necessary for the capstone project to take place.
5. **Build contingency into your CBS**
   - No matter how accurate your estimates are, you should still allow for some contingency in your cost breakdown structure in the CBS

6. Final-check

- The last step in creating a cost breakdown structure is to check your estimates against your available budget.
- If it your estimate is within the available budget, then you can be confident that the financial aspect of your capstone project will be smooth sailing
- If your CBS comes in higher than the available budget, you can look at ways to control costs.

Date

Signature of the student

Signature of the cohort owner

Department of Technical Education
Capstone project

Format- 5
Capstone project Execution Document

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

- Main Deliverables -

1) **Design:** descriptions of the components in the system, Component diagrams, and required design if any.
2) **Description of Technology Used:** provide details of Hardware devices, software products, programming languages etc.
3) **Fabrication**: fabrication or construction details
4) **Testing and validation**: provide the details of Methodologies/ laboratory experiments/ computer programming/ modelling/ simulations/ analysis/ findings etc
5) **Results and inference**

Date

Signature of the student

Signature of the cohort owner

Department of Technical Education
Capstone project

Format- 6
Weekly Meeting Record

<For Cohort owner Use>

Capstone project Title:		
Group Members	1) 2) 3) 4)	▭ Present ▭ Present ▭ Present ▭ Present
Date		
Meeting venue		▭ On Time
Documents Submitted	▭ Status Report	▭ On Time
Issues Group Working on		
Assessment of Progress	▭ Excellent ▭ Good ▭ Satisfactory ▭ Fair ▭ Poor	
Notes/ Concerns/ Comments		

Signature of the Cohort owner

Department of Technical Education
Capstone project

Format- 7
Weekly Status Report

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

Status:

Briefly describe and illustrate the progress.

Highlights
List any items of note. Breakthroughs, accomplishments, major decisions, or changes in the capstone project plan Are you on schedule, ahead of schedule or behind schedule?

Risks or Issues List
In the following table, list any risk or issue that is critical for the success of the capstone project. This could be anything from "*we need to get data*" to "*how do we ensure that the system is usable*" to "*performance is unacceptable*". This should be a complete historical list that is kept from the beginning of the capstone project until the end.
Status should be one of *New*, *ongoing*, *Closed*.

The resolution column should be filled in if the issue or risk has been taken care of.

A capstone project may be expected to have around 1-3 active issues or risks that are being managed (new or ongoing) at any given time. If you have more than three, then either you have a capstone project in serious trouble or your criteria for what is "critical to success" is too loose.

Date	Risk or Issue	Description	Resolution	Status

Contd..

Tasks in Progress or Completed:
List the tasks that each member of the capstone project worked on up to the present time.

Task Name	Description	Team Member Responsible	Percentage Complete

Upcoming Tasks:
List the tasks that each capstone project member is planning to work on in the upcoming Task.

Task Name	Description	Team Member Responsible

Date:

Signature of the students

Department of Technical Education
Capstone project

Format- 8
Student's Daily Log Book

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

Day-1	Date:
Capstone project Name:	
Name of the student	
Name of the Cohort owner:	
Remarks of the Cohort owner:	
Record Main actives of the day (including observation, sketches, discussions, etc): Signature of the Cohort owner	

Note: Prepare a A4 size hard bound Student's Diary/ Daily Log book using this format with college and student details

Department of Technical Education
Capstone project

Format- 9

Capstone project Report Template

The contents of the capstone project report shall be arranged in the following order:

1. Cover Page
2. Inside Title Page
3. Certificate signed by the Cohort owner and HOD
4. Declaration signed by the Candidate
5. Acknowledgements
6. Executive Summary
7. Table of Contents
8. List of Figures
9. List of Tables
10. Abbreviations/ Notations/ Nomenclature
11. Text of the Report
    Chapter 1
    Chapter 2
    --
    --
    Chapter... n
12. References
13. Appendices
14. non-paper materials (if any)

The different Chapters in the capstone project report shall have the following content,

Chapter 1

- Introduction
- Scope of the capstone project

Chapter 2

Capstone project planning

- Work breakdown structure (WBS)
- Timeline Development – Schedule
- Cost Breakdown Structure (CBS)
- Capstone project Risks assessment

Requirements Specification

- Functional
- Non-functional (Quality attributes)

- User input
- Technical constraints

Design Specification

- Chosen System Design
- Discussion of Alternative Designs
- Detailed Description of Components/Subsystems
- Component 1- n

Chapter 3

Approach and Methodology

Discuss the Technology/Methodologies/use cases/ programming/ modelling/ simulations/ analysis/ process design/product design/ fabrication/etc used in the capstone project

Chapter 4

Test and validation

i. Test Plan
ii. Test Approach
iii. Features Tested
iv. Features not Tested
v. Findings
vi. inference

Describe what constitute capstone project success and why? Discuss the product/service tests that will confirm the capstone project succeeds in doing what it intended to do.

Chapter 5

Business Aspects

Discuss the novel aspects of this service or product. Address why a company or investors should invest money in this product or service**.**

- Briefly describe the market and economic outlook of the capstone project for the industry
- Highlight the novel features of the product/service.
- How does the product/service fit into the competitive landscape?
- Describe IP or Patent issues, if any?
- Who are the possible capstone projected clients/customers?

Financial Considerations

- Capstone project budget
- Cost capstone projections needed for either for profit/nonprofit options.

Conclusions and Recommendations

- Describe state of completion of capstone project.
- Future Work
- Outline how the capstone project may be extended

General Guidelines

Report Size - Report may contain maximum of about 100 pages including references and appendices.

Paper Size - Use A4 size paper

Paper Quality - White bond paper weighing 85 g/m2 or more should be used. Photographs or images with dense colors may be printed in single side on glossy paper.

Margins - A margin of 40 mm is to be provided on left and 30 mm on right sides, whereas top and bottom margins should be 30 mm. No print matter should appear in the margin except the page numbers. All page numbers should be centered inside the bottom margin, 20mm from the bottom edge of the paper.

Font - Times New Roman (TNR) 12-point font has to be used throughout the running text. The captions for tables and figures should have font size of 11 and foot notes should be set at font size 10. Font sizes for various levels of headings are given in the table below

CHAPTER 3

TITLE PAGE-CENTERED TNR 17-POINT BOLD ALL CAPS

3.1. Section Heading
Left aligned with number, TNR 17 points, bold and leading caps
3.1.1. Second level section heading
Left aligned with number, TNR 14 points, bold and sentence case**.**
3.1.1.1 Third level section heading
Left aligned with number, TNR 12 points, bold and sentence case.
Fourth-level section heading
Numbered subsections beyond third level are not recommended. However, fourth-level subsection headings may be included without numbering, TNR 12-point font, left aligned and italicized
Running text should be set in 12-point TNR and fully justified. First line of paragraph should have indentation of 15 mm**.**

Line Spacing - The line spacing in the main text should be 1.5, for quotations, figure captions, table captions, figure legends, footnotes, and references. The equations, tables, figures, and quotations Single line spacing should be given.

Table / Figure/equation Format-
Tables, figures, and equations shall be numbered chapter-wise. For example, second figure in Chapter 3 will be numbered Figure 3.2. The figure can be cited in the text as Figure 3.2, Tables shall be numbered similarly (Table 2 in Chapter 3 will be numbered Table 3.2) and shall be cited in the text as Table 3.2. Figure caption shall be located below the figure. Table number and caption shall be located above the table.

Listing of the References
Referencing is a way to give credit to the writers from whom you have borrowed words and ideas. By citing the work of a particular scholar, you acknowledge and respect the intellectual property rights of that researcher. As a student or academic, you can draw on any of the millions of ideas, insights and arguments published by other writers, many of whom have

spent years researching and writing. All you need to do is acknowledge their contribution to your assignment.

References are to be listed after last chapter. They are to be listed in alphabetical order and numbered. Within a reference the line spacing should be single. Each reference should be separated by one blank line. The reference number should be left aligned. The text of the reference should have an indentation of 10 mm. The reference format to be followed for journal articles, text books, conference proceedings etc. are given below.

Journals

1. Parkas, K. (2011). Feedback and optimal sensitivity: Model reference transformations, multiplicative semi norms, and approximate inverses. IEEE Transactions on Automatic Control, 26(2): 301–320.

Text books

1. Myers, D. G. (2007). Psychology (1st Canadian ed.). Worth: New York.

Conference proceedings

1. Payne, D.B. and Gunhold, H.G. (1986). Digital sundials and broadband technology, In Proc. IOOC-ECOC, 1986, pp. 557-998.

Reports

1. Milton, M and Robert, L. (2004). Atmospheric carbon emission through genetic algorithm, Environment and Technical Report No.3., Indian Meteorological Department., New Delhi

Online journals with a DOI (Digital Object Identifier)

1. Krebs, D.L. and Denton, K. (2006). Explanatory limitations of cognitive developmental approaches to morality. Psychological Review, 113(3): 672- 675. doi: 10.1037/0033-295X.113.3.672

Online journals without a DOI

1. Vicki, G.T., Thomae, M., Cullen, A. and Fernandez, H. (2007). Modeling the hydrological impact on Tropical Forests. Forest Ecology, 13(10): 122-132. Retrieved from http://www.uiowa.edu/~grpproc/crisp/crisp.html

Online books

1. Perfect, T.J. and Schwartz, B. L. (Eds.) (2002). Applied metacognition. Retrieved from http://www.questia.com/read/107598848 (--If DOI is available, use the DOI instead of a URL

Chapters from a book

1. Krebs, D.L. and Denton, K. (1997). Social illusions and self-deception: The evolution of biases in person perception. In J. A. Simpson & D. T. Kenrick (Eds.), Evolutionary social psychology (pp.21-48). Hillsdale, NJ: Erlbaum

Appendices

Include data tables, drawings, background calculations, specification lists for equipment used, details of experimental configuration, and other information needed for completeness,

Page Numbering

Page numbers for the prefacing materials (Inside title page, dedication, certificate, declaration, acknowledgements, executive summary, table of contents, etc.) of the report shall be in small

Roman numerals and should be centered at the bottom of the pages.
The numbering of the prefacing material starts from the Inside Title Page. However, the number is not printed on the Inside Title Page. Each new item of the prefacing materials listed above should start on a fresh paper on right page. If the content of the prefacing material exceeds one page, it has to be printed on both sides of the paper by starting from the right-side page. For example, if the item „Table of Contents" extends for 5 pages, it should be printed in fresh paper on right side page with second page of the „Table of Contents" on the back of the paper and then continued. The page numbers of the prefacing material will be printed in small Roman numerals continuously counting blank pages also. However, the numbers are not printed on the blank pages
The body of the report starting from Chapter 1 should be paginated in Arabic numerals and should be centered at the bottom of the pages. The pagination should start with the first page of Chapter 1 and should continue throughout rest of the report. Each side of a sheet of paper should be counted as a separate page, even if the back side of a sheet of paper is blank. The odd numbered pages are always on the right and even-numbered pages are always on the left. If the end of a chapter is in odd page (right side page) the next chapter should start on odd page i.e., on a fresh paper, and should be numbered as odd only by counting the blank even page also. However, the page number is not printed on the blank pages.
Each of the items - Inside cover page, Certificate, Acknowledgements, executive summary, Table of Contents, List of Figures, List of Tables, Abbreviations, Notations, Nomenclature, each new Chapter, References, and each new Appendix should start on an odd page i.e., on the right side

Non-Paper Material

A report may contain non-paper material, such as specimen, CDs and DVDs, Pen drive if necessary. They have to be accommodated in a closed pocket in the back cover page of the report. The inclusion of non-paper materials must be indicated in the Table of Contents. All non-paper materials must have a label each clearly indicating the name of the candidate, student Register number and the date of submission**.**

Binding

Two hard bounded copies of the capstone project Report shall be submitted for evaluation, the cover page should be printed on sky blue card of 300 g/m2 or above**.** One copy is used for Semester End Examination and after the exam it should be maintained in the concerned Head of the department and another copy is maintained at cohort owner

Electronic Copy

An electronic version (PDF) of the capstone project report should be submitted to the cohort owner and Head of the department. The file name should contain title of the capstone project, student Register number and date of submission.