

**INTERNSHIP LOGBOOK**

**mitwpu.edu.in**









**Name:** MUSKAN HITESHKUMAR PATEL

**PRN No.:** 1032200264

**Division/Panel:** R&A

**School:** SCHOOL OF MECHANICAL ENGINEERING

**Programme:** BTECH MECHANICAL (ROBOTICS & AUTOMATION) ENGINEERING

**Company:** INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

**Academic Year:** 2023-24 **Semester:** VIII

**Start Date:** 15th JANUARY, 2024 **End Date:** 14th MAY, 2024

**INTERNSHIP LOGBOOK**



**Preface**

**The objective of an internship program is to expose the students to the dynamics of an organization and to integrate classroom learning with practical experience. The internship benefits the students through the experience earned, while the host organization benefits through availability of young and enthusiastic interns who are having new ideas, to aid in execution of organizational tasks or projects for the internship duration.**

**The Internship logbook will serve as an indicator to evaluate the progress of the student during internship period. The logbook records the details pertaining to planning, monitoring, progress and assessment of the work carried out by the student. This logbook would be useful across all the schools under the Faculty of Engineering and Technology, MIT-WPU.**

**The idea of internship logbook was conceptualized by Prof. Dr. Mangesh Bedekar, HoS and Prof. Dr. Balaji Patil, Associate HoS, School of Computer Engineering and Technology. It was prepared by Prof. Dr. Sukhada Bhingarkar and Prof. Amit Savyanavar from School of Computer Engineering and Technology under the guidance of Prof. Dr. Prasad Khandekar, Dean, Engineering and Technology, MIT-WPU.**





#### INDEX

**Student Details**

##### 1

[Course Structure 3](#_TOC_250007)

Do’s & Don’ts 4

[Student Undertaking 5](#_TOC_250006)

[Daily Attendance Sheet 6](#_TOC_250005)

[Weekly Planning & Reporting 9](#_TOC_250004)

[Details of Meeting between College Supervisor and Company Supervisor 25](#_TOC_250003)

Periodic Progress Report (after first month) 26

Periodic Progress Report (after second month) 27

[Evaluation by Company Supervisor 28](#_TOC_250002)

[Overall Assessment 29](#_TOC_250001)

[Intern Testimonial 30](#_TOC_250000)

Annexure – 1 (Template for Midterm Presentation) 31

Annexure – 2 (Template for Final Presentation) 32

Annexure – 3 (Title Page of Internship Report) 33

**Annexure – 4 (Certificate of Internship)**



**34**

**35**

**Annexure – 5 (Chapter Scheme of Final Internship Report)**





#### STUDENT DETAILS



|  |  |
| --- | --- |
| **PRN Number** | 1032200264 |
| **Name of Student** | Muskan Hiteshkumar Patel |
| **Panel Number** |  |
| **Email ID** | muskan.hp03@gmail.com |
| **Contact Number** | 8160215253 |
| **Parent / Guardian’s Name** | Hiteshkumar Patel |
| **Parent / Guardian’s Email ID** | hkumar.n@gmail.com |
| **Parent / Guardian’s**  **Contact Number** | 7046200039 |
| **Company Details** | |
| **Name of Company** | Indian Institute of Technology Bombay (IITB) |
| **Job Title** | Research Intern |
| **Description/Details of Company** | IITB has grown from strength to strength to emerge as one of the top technical universities in the world. The institute is recognized worldwide as a leader in the field of engineering education and research. |
| **Company URL** | https://www.iitb.ac.in/ |
| **Job Location** | Powai, Mumbai |
| **Stipend Offered** | Unpaid |
| **Company Supervisor Details** | |
| **Name of Company Supervisor** | Prof. Vivek Sangwan |
| **Email ID** | vivek.sangwan@iitb.ac.in |
| **Contact Number** | (+91)-22-25769357 |

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| **Internship Details** | |
| **Project Title** | Design and Control of Torso Balancing Mechanism for Bipedal Walking Robot |
| **Domain** | Robotics |
| **Technology / Tools Requirements** | Solidworks, MATLAB, Microcontroller, Actuators, Sensors, PID Controller |
| **Objectives** | * To obtain the dynamical equations of the balanced link and simulate the system using MATLAB. * To design a torso balancing mechanism using solidworks. * Manufacture the biped and perform torso attitude control and also implement controller. |
| **Project Plan** | 15th Jan-14th Feb: Understanding the existing biped and its working and deriving the dynamical equations for a new system.  15th Feb-14th March: Simulating the system in MATLAB and analyzing the error. Designing the new biped model using solidworks.  15th March-14th April: Material selection, fabricating the model.  15th April-14th May: Complete the fabrication and start with development of mechatronic system for biped. Balance the system and understand the algorithm to balance torso of the biped. |
| **Outcomes** | * Knowledge about numerical optimization in MATLAB ode45 * Mechatronic system for torso balancing mechanism of the biped. * Understand the algorithm to balance torso and later use the same to make the biped walk. |



#### COURSE STRUCTURE



|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | | | | | | INT300 / INT400 | | | |
| **Course Title** | | | | | | INTERNSHIP | | | |
| **Trimester:** | | | | | | One Trimester in T.Y. B.Tech. / B.Tech. | | | |
| **Course Objectives:**   * Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job. * Get exposed to the current technological developments relevant to the object area of training. * Use the experience gained from the ‘Industrial Internship’ in discussions held in the classrooms. * Learn to apply the knowledge in real industrial solutions. * Gain experience in writing reports in technical works/projects or in managerial situation. * Expose students to the professional responsibilities and ethics. | | | | | | | | | |
| **Course Outcomes:**   * Demonstrate the technical / managerial knowledge by applying the same to solve the real-life problem or situation, as the case may be. * Identify the appropriate method(s) / tool(s) to deal with the situation. * Understand professional responsibilities and ethics. * Collect and organize data into meaningful information. * Develop professional communication skills and interpersonal skills. | | | | | | | | | |
| **Internship Outline and Policy:**   * Students may opt for an internship for only one Trimester out of VII, VIII, IX, X, XI or XII. * Internship will be considered for credits/marks if it is for a minimum of one month. * If students who opt for 3 months in any of the Trimester VII, VIII, IX, X, XI or XII, the credits and marks for the internship will be lieu of the total subject credits offered for VII, VIII, IX, X, XI or XII respectively. * Pre-requisite courses are required for professional electives courses only. Additional credits are for pre-requisite courses that the student has to complete either by doing bridge courses or out- line course. One pre-requisite course will have a CCA of 100 marks mapped to 2 Credits. 1 Credit = approximately 40 to 45 hours of working in an industry/organization. * For Example: A Trimester where the total subject offered are equal to 12 Credits. The credits in lieu of these subjects if a student opts for Internship in T.Y. B.Tech. / B.Tech. are 12 Credits of Intern- ship, the total assessment marks 600 are as given below | | | | | | | | | |
|  | **Internal Assessment Marks** | | | | | | | Total | Credits |
|  | **Internal Assessment (CCA) 50%** | | | | **External Assessment (LCA) 50%** | | | (100%) | (100%) |
|  | Week’s Report (5%) | Periodic Report (10%) | Midterm Presentation (20%) | Final Report (15%) | Company Supervisor’s Feedback (25%) | | Final Presentation & Submission Report (25%) | **600** | **12** |
|  | **30** | **60** | **120** | **90** | **150** | | **150** |
|  | **300** | | | | **300** | | |
|  | | | | | | | | | |



#### DO’s

* Report on the first day of Internship to the venue as communicated by the host organization.
* Be punctual
* Always wear formal attire
* Adhere to the timelines of evaluation components submission / compliance
* Stay in contact with College Supervisor throughout the Internship duration
* Exhibit pro-activeness & develop learning attitude (Remember Internship is the best opportunity to observe & get experience of how industry functions)
* Be polite with Company Supervisor and other employees of the host organization.
* Contact College Supervisor, in case of any issues at the host organization / with Company Supervisor
* Be sincere in your approach towards Internship.

#### DON’Ts

* Exhibit over-smartness or ‘I know everything’ attitude.
* Prepare fake documentation or show some work as your internship which you have not done.
* Insist on getting reimbursements for travelling/ conveyance / food etc.
* Use host organization’s resources like stationery or facilities like transport, canteen etc. unless permitted by the competent authority from the host organization.



#### STUDENT UNDERTAKING

I, the undersigned, herewith accept the allotment to pursue internship at M/s **IIT BOMBAY** from **15th January, 2024** to **14th May, 2024**.

I herewith declare that I accept and agree with the Code of Conduct as specified by the industry/university either within or outside the organization during my period of my internship.

I shall take the complete responsibility for my behavior during internship and I assure you that I will not directly or indirectly involve in any of the situation that may interfere with the Code of Conduct.

I understand that I shall be liable for suitable disciplinary action in case of any violation of the guidelines, as well as the employer’s rules and regulations. I further undertake to see the internship to its completion and put my best efforts towards this internship.

Name of Student: MUSKAN HITESHKUMAR PATEL



Sign:



#### DAILY ATTENDANCE SHEET

**Purpose:** To keep track of daily attendance.

**How to Use:** Every day the intern records the time he/she arrives and the time he/she leaves. The Company Supervisor should sign it.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Week 1** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | Medical | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | Leave | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 1: 15/01 to 20/01** | | **Company Supervisor’s Sign:** | | | | |

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| --- | --- | --- | --- | --- | --- | --- |
| **Week 2** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Republic | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Day | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 2: 22/01 to 27/01** | | **Company Supervisor’s Sign:** | | | | |

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| **Week 3** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 3: 29/01 to 03/02** | | **Company Supervisor’s Sign:** | | | | |

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| **Week 4** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 4: 05/02 to 10/02** | | **Company Supervisor’s Sign:** | | | | |

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| **Week 5** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 5: 12/02 to 17/02** | | **Company Supervisor’s Sign:** | | | | |
|  | | | | | | |
| **Week 6** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 6: 19/02 to 24/02** | | **Company Supervisor’s Sign:** | | | | |



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| **Week 7** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 7: 26/02 to 02/03** | | **Company Supervisor’s Sign:** | | | | |

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| **Week 8** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 8: 04/03 to 09/03** | | **Company Supervisor’s Sign:** | | | | |

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| **Week 9** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 9: 11/03 to 16/03** | | **Company Supervisor’s Sign:** | | | | |

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| **Week 10** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 10: 18/03 to 23/03** | | **Company Supervisor’s Sign:** | | | | |

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| **Week 11** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | Holi | Leave | Leave | Leave | Good Friday | Off |
| Time Out | Leave | Leave | Leave | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 11: 25/03 to 30/03** | | **Company Supervisor’s Sign:** | | | | |

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| **Week 12** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 12: 01/04 to 06/04** | | **Company Supervisor’s Sign:** | | | | |
|  | |  | | | | |
| **Week 13** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | Gudi Padwa | 9:30 am | Ramzan Eid | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 13: 08/04 to 13/04** | | **Company Supervisor’s Sign:** | | | | |



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| **Week 14** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 14: 15/04 to 20/04** | | **Company Supervisor’s Sign:** | | | | |



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| --- | --- | --- | --- | --- | --- | --- |
| **Week 15** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In | 9:30 am | 9:30 am | 9:30 am | 9:30 am | Official | Off |
| Time Out | 6:00 pm | 6:00 pm | 6:00 pm | 6:00 pm | Leave | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 15: 22/04 to 27/04** | | **Company Supervisor’s Sign:** | | | | |

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| --- | --- | --- | --- | --- | --- | --- |
| **Week 16** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Time In |  |  |  |  |  | Off |
| Time Out |  |  |  |  |  | Off |
| Intern Sign |  |  |  |  |  |  |
| **Week 16: 29/04 to 04/05** | | **Company Supervisor’s Sign:** | | | | |

##### Overall Attendance related comments (to be filled by Company Supervisor):

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Name & Sign of Company Supervisor:



**Week 1**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 15/01/2024 To 20/01/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Read and understand research papers on biped and balancing frame using flywheel | Collected 10 research papers based on three major concepts:   1. Cubli: The Cubli is a 15 × 15 × 15 cm cube that can jump up and balance on its corner. Reaction wheels are mounted on three faces of the cube rotate at high angular velocities to balance itself. This paper describes the dynamical model of the balancing using flywheels/reaction wheels. 2. Flywheels: To understand the selection of flywheel dimensions for a particular application. Working of flywheel in different applications – one of them being the maintaining or changing direction of the satellites. 3. Biped: To study and understand the working of the existing bipeds and their mathematical modelling along with the algorithms involved in a biped system. |  |
| Tuesday |
| Wednesday |
| Thursday |
| Friday |
| Saturday | Day Off | | |
| **Learnings in this week:** | | Understood the flywheel working to balance a frame and modelling of bipedal system. |  |
| **Cumulative Progress till date (% of total Work):** | | 2% |  |
| **Plan for next week:** | | To prepare a rough sketch for a three-link system where one link(frame) is connecting the other two links. |  |

**Week 2**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 22/01/2024 To 27/01/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Understand the need of flywheel in the system and check how to decide dimensions of the flywheel | Derived the equation to find the radius of the flywheel depending on the frame inertia as to balance the frame, the moment of inertia of frame should be equal to the inertia of the flywheel. |  |
| Tuesday |
| Wednesday | Draw a basic schematic diagram of the three-link system where one of the links is frame connecting other two links | Successfully completed the task and the schematic diagram was verified. |  |
| Thursday | Derive the dynamics of a simple mechanical system using two different methods- Lagrangian and Newton’s method and also understand the working of ODE45 solver in MATLAB | Derived the dynamical equations of an inertia wheel on which torque is applied. Also, learnt the basics of ODE45 solver in MATLAB by simulating the derived equation in MATLAB using ode45 and pd controller. |  |
| Friday |
| Saturday | Day Off | | |
| **Learnings in this week:** | | Learnt the concept of inertia, design and also the working of MATLAB ode45. |  |
| **Cumulative Progress till date (% of total Work):** | | 5% |  |
| **Plan for next week:** | | Start with the solidworks design of the desired biped parts and later assemble them. |  |



**Week 3**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 29/01/2024 To 03/02/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Start with the solidworks design of the desired biped model | Started with the solidworks design of the parts involved in the complete desired biped system. Successfully made major parts of the biped which are the three links – two being 2040 aluminum profiles and one is the frame also called torso which will have two BLDC motors mounted over its diagonal extreme ends. |  |
| Tuesday |
| Wednesday | Understand the available microcontroller XEP100 for later use and the importance of motor control | Understood the basics of the XEP100 microcontroller by studying the pins and functions of them using the datasheet given. Also, understood that to balance the torso the speed and direction control of motor is the most important part. |  |
| Thursday | Derive dynamical equations for a system where only one wheel is used to balance the torso | Successfully derived the dynamical equations of the given system using two methods to verify them simultaneously. Also, verified both of the equations. |  |
| Friday |
| Saturday | Day Off | | |
| **Learnings in this week:** | | XEP100 microcontroller, lagrangian and newton’s methods to derive dynamics of given system. |  |
| **Cumulative Progress till date (% of total Work):** | | 10% |  |
| **Plan for next week:** | | To simulate the derived equations in MATLAB and continue with the solidworks design. |  |

**Week 4**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 05/02/2024 To 10/02/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Continue with the design of parts and start assembling them | All the parts of the system are designed and also started with the assembly, deciding the size of nuts and bolts, angle joints and bearings. |  |
| Tuesday |
| Wednesday | Simulating the derived equations of given system in the last week using MATLAB ode45 | Firstly, performed energy check by keeping the system torque=0 first, then torque=constant and then a sine function. The equations are hence verified and then simulated the system. |  |
| Thursday |
| Friday | Understand the use and working of the potentiometer by interfacing it with XEP100 | Successfully interfaced the potentiometer with XEP100 and also understood the concept of analog to digital converter. |  |
| Saturday | Day Off | | |
| **Learnings in this week:** | | Simulation of wheel-torso system and the working of potentiometer and analog to digital converter. |  |
| **Cumulative Progress till date (% of total Work):** | | 20% |  |
| **Plan for next week:** | | Finalizing Solidworks Assembly and understand the concept of PWM. |  |



**Week 5**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 12/02/2024 To 17/02/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Finalize the solidworks assembly and the cad model of the desired biped system | Finalized the design after making the required changes in the cad. |  |
| Tuesday |
| Wednesday | Understand the PWM signal and its purpose | Read about PWM signal and understood the purpose of PWM and also that it will be used in motor speed and direction control. |  |
| Thursday | Interfacing DC motor with XEP100 microcontroller and control its no. of rotations along with speed and direction | Successfully completed the given task and plotted the PWM signals with different duty cycles on oscilloscope. |  |
| Friday |
| Saturday | Day Off | | |
| **Learnings in this week:** | | PWM signals, DC motor speed and direction control using XEP100 microcontroller. |  |
| **Cumulative Progress till date (% of total Work):** | | 25% |  |
| **Plan for next week:** | | Finalizing the design of individual parts to send it for fabrication and also deriving equations for our actual system. |  |

**Week 6**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 19/02/2024 To 24/02/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Finalizing the parts to send for fabrication | Started with the finalization of the parts of the complete biped model. |  |
| Tuesday |
| Wednesday | Derive equations for a system with two flywheels of same mass and radius, producing two different torques to balance the torso which is displaced by an initial angle. | Worked on the equation derivation of the given system using lagrangian method first but encountered few issues then also derived equations using newton’s method but obtained two different equations of same system by two different methods. |  |
| Thursday |
| Friday |
| Saturday | Day Off | | |
| **Learnings in this week:** | | Concept of relative frames, Virtual space |  |
| **Cumulative Progress till date (% of total Work):** | | 30% |  |
| **Plan for next week:** | | Work on the errors in the equations of the given system and prepare drawings of parts for fabrication. |  |



**Week 7**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 26/02/2024 To 02/03/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Find the error in the dynamic equation and resolve it to get balanced system | Found the error and resolved the equations and obtained the output as required in the matlab ode45. |  |
| Tuesday |
| Wednesday | Work on the hardware required to balance the torso along with preparing a circuit and make it work | Started with interfacing Arduino uno with BLDC motor and Simonk 30A ESC, potentiometer and MPU 6050 gyroscope individually first. Also, got familiar with Teensy 4.1 microcontroller to replace Arduino uno with Teensy 4.1 later. |  |
| Thursday |
| Friday |
| Saturday | Day Off | | |
| **Learnings in this week:** | | Hardware interfacing, Arduino Uno, Teensy 4.1, BLDC Motor |  |
| **Cumulative Progress till date (% of total Work):** | | 35% |  |
| **Plan for next week:** | | Continue working on the hardware to obtain the required system. |  |

**Week 8**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 04/03/2024 To 09/03/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Obtain a visualization for the obtained output of the dynamic equation using MATLAB ode45 | Performed 2D visualization for the obtained dynamical equations of the 2-flywheel torso system. |  |
| Tuesday |
| Wednesday | Work on hardware and understand more about the components to be used for the torso balancing | Started with the reading of datasheet of the bldc motor – AK2212 and its speed controller- Simonk 3000A. Also, studied the datasheet and calibration of the gyroscope-MPU6050. |  |
| Thursday |
| Friday |
| Saturday | Day Off | | |
| **Learnings in this week:** | | Data Visualization using ode45, hardware calibration and datasheet reading. |  |
| **Cumulative Progress till date (% of total Work):** | | 40% |  |
| **Plan for next week:** | | Continue with the hardware interfacing and also focus on the solidworks design. |  |



**Week 9**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 11/03/2024 To 16/03/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Work on the hardware interfacing and coding the bldc motor to rotate at constant speed followed by variable speed at user input | Successfully implemented the mentioned task but encountered a problem which needs to be solved and also started studying about the periodic interrupt timer (PIT) to rotate a dc motor for a particular time period interfaced with XEP100 microcontroller. |  |
| Tuesday |
| Wednesday |
| Thursday | Make the changes in the solidworks design as discussed in the meeting and prepare a prototype design for testing the balance | Made the changes required with perfect dimensions and positions of the hardware components are also specified. |  |
| Friday |
| Saturday | Day Off | | |
| **Learnings in this week:** | | BLDC motor speed control, PIT, XEP100 microcontroller. |  |
| **Cumulative Progress till date (% of total Work):** | | 45% |  |
| **Plan for next week:** | | Work on calibration of the esc and also start with the set-up preparation |  |

**Week 10**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 18/03/2024 To 23/03/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Solve the problem faced while coding the bldc motor and find out the mistake or proper explanation for the issue encountered | There are two ways to generate pwm signals required to rotate the motor- servo library command write.microseconds() and the other way is using the command analogwrite(). The motor is rotating with the servo library but wasn’t giving any response to analogwrite(). Checked the signals using easyscope but the signals are same. |  |
| Tuesday |
| Wednesday | Work more on signals and make table of the readings obtained at different duty cycle | Prepared the table of the signal readings obtained by the two commands – writemicroseconds() and analogwrite(). Found the problem which is the esc has temporary memory/flash memory hence it needs to be calibrated every time we switch off the battery. Also, the esc needs 2sec delay to get to the armed position of the rotor. |  |
| Thursday |
| Friday | Check individual components and then calibrate each one of them. | Successfully calibrated esc and checked the working of every component. |  |
| Saturday | Day Off | | |
| **Learnings in this week:** | | Signal behavior, servo library, easyscope, ESC behavior. |  |
| **Cumulative Progress till date (% of total Work):** | | 50% |  |
| **Plan for next week:** | | Work on the code for PID control for the balancing of torso. |  |



**Week 11**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 25/03/2024 To 30/03/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Holi (Official Holiday) | | |
| Tuesday | Leave (Permitted) | Worked on the code for PID control and almost prepared the code to test the balancing of torso. |  |
| Wednesday |
| Thursday |
| Friday | Good Friday (Official Holiday) | | |
| Saturday | Day Off | | |
| **Learnings in this week:** | | PID controller, Arduino IDE Wire library and few other commands. |  |
| **Cumulative Progress till date (% of total Work):** | | 55% |  |
| **Plan for next week:** | | Prepare the final set-up and test the code and implement the balancing of the same set-up. |  |

**Week 12**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 01/04/2024 To 06/04/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Start with the cutting and filing of the wooden parts required for the prototype | Selected the wood- plywood and obtained the parts those are required to build the prototype. Also, bought C-bracket to mount the wooden planks on it. Laser cut the acrylic sheet to mount the bldc motor. |  |
| Tuesday |
| Wednesday |
| Thursday | Finalize the prototype building and work on the final code to balance the torso | Assembled the parts and finalized the set-up and mounted the electronic components and wrote a code to balance the torso but few errors are encountered. |  |
| Friday |
| Saturday | Day Off | | |
| **Learnings in this week:** | | Manufacturing, cutting, filing, Arduino ide, different types of wood |  |
| **Cumulative Progress till date (% of total Work):** | | 70% |  |
| **Plan for next week:** | | Finalize the code, build a pcb for the electronic components and balance the torso |  |



**Week 13**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 08/04/2024 To 13/04/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Analyze the system by plotting graph to note the noise affecting the output | Tried to plot graph using Arduino Serial Plotter but that plots with respect to baud rate instead of the parameters we want. |  |
| Tuesday | Gudi Padwa Holiday | | |
| Wednesday | Note the noise and order the components required to complete the set-up | Noted the noise without the motors running and ordered the components required. |  |
| Thursday | Ramzan Eid Holiday | | |
| Friday | Complete the set-up and test the PID code and make changes with required | Completed setting up of the prototype and also tested the code but encountered few issues. |  |
| Saturday | Day Off | | |
| **Learnings in this week:** | | Effect of noise on the output of the system, minimizing the noise, prototype building |  |
| **Cumulative Progress till date (% of total Work):** | | 80% |  |
| **Plan for next week:** | | Solve the issue with the code and finally balance the torso prototype on its edge. |  |

**Week 14**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 15/04/2024 To 20/04/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Finalize the material for flywheel/inertia wheel and fabricate it by any method required. | Fabricated the inertia wheels of material, acrylic, by laser cutting. The inertia wheels have 3mm holes to put on mass later if required. |  |
| Tuesday |
| Wednesday | Resolve the issue with the code and run it to test the balancing of the system | Found the error and tested the code after changes but the system doesn’t balance. It rotates acting due to the inward force by the motors. Checked few other videos and research papers to understand this reaction force and limited the movement of the set-up. But still the system is not balanced. |  |
| Thursday |
| Friday |
| Saturday | Day Off | | |
| **Learnings in this week:** | | Laser cutting, Reaction force due to rotating motors, Few functions in Arduino IDE. |  |
| **Cumulative Progress till date (% of total Work):** | | 85% |  |
| **Plan for next week:** | | Calibrate the mpu6050 sensor again and set the zero for x-axis accurately, run the motors with same pwm signals |  |



**Week 15**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 22/04/2024 To 27/04/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday | Calibrate the mpu6050 sensor and set the zero for x-axis accurately. | Accurately set the zero for x-axis and then calibrated the sensor. |  |
| Tuesday | Try to give same pwm signals to both the motors and observe the output. | Gave the same pwm signals to both the motors but there is no reaction torque experienced to balance the set-up. |  |
| Wednesday | Increase the moment of inertia of the inertia wheels/flywheels. | Increased the moment of inertia of the wheels and ran the code, there is reaction torque at variable speed but also encountered a lot of vibration due to the mass of wheels. |  |
| Thursday | Use the drone propellers and change the orientation of the bldc motors. | Did an experiment with the drone propellers with the context of thrust being used to balance the set-up but couldn’t get the expected result. |  |
| Friday | Official Leave (Final Review) | | |
| Saturday | Day Off | | |
| **Learnings in this week:** | | MPU6050 sensor, thrust concept to balance torso, moment of inertia. |  |
| **Cumulative Progress till date (% of total Work):** | | 90% |  |
| **Plan for next week:** | | Find the solution for the problem and balance the torso. |  |

**Week 16**

#### WEEKLY PLANNING & REPORTING

##### Record the tasks completed on each day. Dates: From 29/04/2024 To 04/05/2024

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Tasks/Activities planned** | **Tasks/Activities completed** | **Comments by Company**  **Supervisor** |
| Monday |  |  |  |
| Tuesday |  |  |  |
| Wednesday |  |  |  |
| Thursday |  |  |  |
| Friday |  |  |  |
| Saturday | Day Off | | |
| **Learnings in this week:** | |  |  |
| **Cumulative Progress till date (% of total Work):** | |  |  |
| **Plan for next week:** | |  |  |



#### DETAILS OF MEETING BETWEEN COLLEGE SUPERVISOR AND COMPANY SUPERVISOR

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sr. No.** | **Date** | **Activity Planned in Last Review** | **Activity Completed** | **Signature of College Supervisor** | **Signature of Company Supervisor** |
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**PERIODIC PROGRESS REPORT**

##### (After first month)

**Periodic Progress Report No.- I Day & Date: Friday, 09/02/2024**

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| --- |
| **Tasks performed in first month:**  Read research papers on bipedal walking robot and flywheels, worked with MATLAB ODE45, Derived the dynamical equations for one flywheel system and simulated it in matlab, Studied XEP100 microcontroller and also performed new tasks with potentiometer interfacing with this XEP100. Understood the concept of analog to digital converter. Started with solidworks design of the torso to be balanced. |
| **Important Meetings/ Discussions attended in first month:**  Meeting to decide the task and project to complete within these 4 months internship duration and introduction to the other group members.  Meeting to analyze the progress of the project at the end of the month when the equations derived checked and the final result was shown for one flywheel system. |
| **Learnings from work completed in first month:**  Matlab simulations, differential equation solver – ode45 in matlab, XEP100 microcontroller, potentiometer, ADC, Lagrangian and Newtonian method of deriving the dynamical equations for one flywheel system. |
| **Cumulative Progress till date (% of total Work):**  20% of the total project is completed till date. |
| **Plan till next Periodic Report submission:**  Finalize the SolidWorks design and work on the concept of PWM signals along with running the dc motor using XEP100 microcontroller. Derive the dynamical equations for the two-flywheel system which is the actual system which is needed to balance the torso in this project. |

##### Signature of Student:

**Signature of Company Supervisor:**

**Signature of College Supervisor:**



#### PERIODIC PROGRESS REPORT

##### (After second month)

**Periodic Progress Report No.- II Day & Date: Friday, 08/03/2024**

|  |
| --- |
| **Tasks performed in second month:**  Finalized the design of the torso and drafted the drawings and made it ready to manufacture the parts, Interfaced the DC motor with XEP100 and generated PWM signals to run the motor at different speeds. Derived the equation for two-flywheel system and simulated it in matlab and improved the model. Also, prepared 2D visualization of balancing the torso in Matlab. Interfaced Bldc motor, mpu6050 with teensy 4.1 to understand its working. |
| **Important Meetings/ Discussions attended in second month:**  Discussed the progress of the project and also the components required to be bought for the pneumatic system.  Also, discussed the final design and came up with a major change in the design to make it easier to understand the algorithm of balancing of torso. |
| **Learnings from work completed in second month:**  Concept of PWM signals, working of DC motor, complete two-flywheel system and 2D visualization in Matlab, Teensy 4.1 microcontroller, BLDC motor, MPU6050(Gyroscope + accelerometer), interfacing of these components. |
| **Cumulative Progress till date (% of total Work):**  40% of the total project is completed till date. |
| **Plan till next Periodic Report submission:**  Make changes in the design and also work on the hardware perspective of the project. Calibrate the electronic speed controller and MPU6050. Understand the datasheet of every component being used. Also, understand the concept of Periodic Interrupt Timer (PIT) using XEP100 microcontroller. |

##### Signature of Student:

**Signature of Company Supervisor:**



**Signature of College Supervisor:**



#### PERIODIC PROGRESS REPORT

##### (After third month)

**Periodic Progress Report No.- III Day & Date: Friday, 05/04/2024**

|  |
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| **Tasks performed in third month:**  Performed a task to run the dc motor at a certain speed for a certain time duration using PIT and XEP100. Also, got the encoder reading while the motor is rotating. Made the changes in the design as discussed in the previous meeting. Verified the design and built the prototype to be balanced. Worked on the code but found few errors. Calibrated the components and noted a table of signal behavior generated by analogWrite() and write.Microseconds(). |
| **Important Meetings/ Discussions attended in third month:**  Meeting to discuss the updated design and finalizing it to start with the hardware part – cutting of wood, drilling and filing.  Discussed about the set-up prepared and the next step to start with the balancing of the torso. |
| **Learnings from work completed in third month:**  PIT, Encoder, signal behavior, Calibration of MPU6050 and ESC, ESC behavior and its datasheet, cutting and filing of wood, Laser cutting of acrylic sheet to prepare motor mount. |
| **Cumulative Progress till date (% of total Work):**  70% of the total project is completed till date. |
| **Plan till next Periodic Report submission:**  Finalize the code to balance the torso, take note of the behavior of the system at different gains and analyze the complete data to conclude the project observations. |

##### Signature of Student:

**Signature of Company Supervisor:**



**Signature of College Supervisor:**



#### PERIODIC PROGRESS REPORT

##### (After fourth month)

**Periodic Progress Report No.- IV Day & Date:**

|  |
| --- |
| **Tasks performed in fourth month:** |
| **Important Meetings/ Discussions attended in fourth month:** |
| **Learnings from work completed in fourth month:** |
| **Cumulative Progress till date (% of total Work):** |
| **Plan till next Periodic Report submission:** |

##### Signature of Student:

**Signature of Company Supervisor:**



**Signature of College Supervisor:**



#### EVALUATION BY COMPANY SUPERVISOR

Please assess the internship work on the following 5-Point Scale:

##### 5=Excellent 4=Good 3= Satisfactory 2= Below Average 1=Poor

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sr.**  **No.** | **Parameters** | **Excellent (5)** | **Good (4)** | **Satisfactory (3)** | **Below Average (2)** | **Poor (1)** |
| 1 | Ability to understand a practical situation & formulate a problem |  |  |  |  |  |
| 2 | Ability to collect, collate and analyze appropriate data |  |  |  |  |  |
| 3 | Ability to apply theoretical concepts to practical situations |  |  |  |  |  |
| 4 | Ability to work independently and demonstrate pro-activeness |  |  |  |  |  |
| 5 | Working as part of a Team |  |  |  |  |  |
| 6 | Oral Communication |  |  |  |  |  |
| 7 | Written Communication |  |  |  |  |  |
| 8 | Attendance |  |  |  |  |  |
| 9 | Punctuality |  |  |  |  |  |
| 10 | Suitability of Office Attire |  |  |  |  |  |
| 11 | Behavior |  |  |  |  |  |
| 12 | Employability Skills |  |  |  |  |  |
| 13 | Flexibility |  |  |  |  |  |
| 14 | Organizing own work |  |  |  |  |  |
| 15 | Attitude to work |  |  |  |  |  |
| 16 | Relationship with Supervisor |  |  |  |  |  |
| 17 | Quality of Internship Work |  |  |  |  |  |

**Additional comments**

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**OVERALL ASSESSMENT**

The Intern benefits from formal feedback of their strengths, weaknesses and achievements during the Internship.

**The company supervisor is requested to write it below:**

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**Company Supervisor’s Signature**

**Date**



#### INTERN TESTIMONIAL

School of Mechanical Engineering, MIT-WPU is interested to receive feedback about the Intern ship experience.

**Please write it below:**

Firstly, I had the opportunity to meet some very remarkable individuals from throughout the nation, including some highly skilled and intelligent people. I was employed by a faculty member in the department of mechanical engineering. I had to design and analyze the algorithm to balance the torso prototype that they could utilize later to balance the torso of the existing model of bipedal walking robot. I always wanted to work on robots and their control system but had never had the chance before then. This offered me a nice look at options beyond the standard technological arena. I never felt under any strain at work, and everything always seemed to fall into place. The internship turned out to be an unforgettable experience thanks to the invaluable instruction of my mentor, Prof. Vivek Sangwan. Throughout the whole process, my coworkers provided me with unwavering support. The other individuals in the area were also quite kind and welcoming. There was always something fresh to learn. There was considerably calmer in the room since my mentor and guide provided us with ample of time and assistance to become acquainted with the work we were doing. In addition to work, there was plenty of leisure to see Mumbai, a stunning city. I have never been required to work over my regular working hours. The weekends were entirely free. An extensive collection of books and a calm, inspiring environment can be found in the central library. I also got the advantage to stay in the IITB hostels from April. The hostels are neat and well-equipped with beds, fans, desks, and outlets. Three students share a room in one building for girls, while the other buildings house solo rooms. The food at the campus stores is inexpensive and hygienic, and there are monthly meal plans available. Despite the intense summer heat and extreme humidity, I was able to manage. All in all, my time at IIT Bombay was fantastic and something I will cherish forever.





**Signature of Student**



### TEMPLATE FOR MID-TERM PRESENTATION

* Internship Project Title
* Internship Project Objective
* Tasks Completed till Date
* Key Learnings till Date
* Key Suggestions till Date
* Action Plan for the Remaining Period of Internship



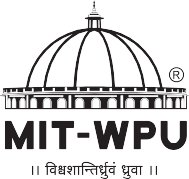


### TEMPLATE FOR FINAL PRESENTATION

* Internship Project Title
* Internship Project Objective
* Theoretical Background
* Methodology Followed
* Data Collection & Analysis
* Conclusions / Findings / Observations
* Key Suggestions
* Key Learnings



#### TITLE PAGE OF INTERNSHIP REPORT

***Company Logo***



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#### TITLE

(2 blank lines)

An Internship Report Submitted to

#### DR. VISHWANATH KARAD MIT WORLD PEACE UNIVERSITY

(2 blank lines)

Submitted by,

#### Student Name (PRN number)

(2 blank lines)

Under the supervision of

#### Company Supervisor Name

and

#### College Supervisor Name

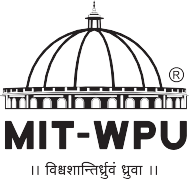
**School of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

#### MIT World Peace University, Pune Kothrud, Pune-411038

**(Period from \_\_\_\_\_\_\_\_\_\_\_ to )**

## ANNEXURE - 4

#### CERTIFICATE OF INTERNSHIP

***Company Logo***



**CERTIFICATE**

This is to certify that the Internship Report entitled

#### TITLE

Submitted by

##### Student Name (PRN number)

(14pt, Bold)

in partial fulfillment of requirement of an Internship at **Company Name,** is a bonafide record of the work carried out by him/her during the period from to . He/She has worked under the su- pervision of **Company Supervisor Name and College Supervisor Name.** He/She has fulfilled the require- ment of the submission of the Internship report for Third/Fourth Year Engineering as per the syllabus prescribed by the MIT World Peace University, Pune. The material obtained from other sources has been duly acknowledged in the report.

|  |  |  |
| --- | --- | --- |
| **Name** | **Name** | **Name** |
| **Company Supervisor** | **College Supervisor** | **Head,**  **School of \_\_\_\_\_\_\_\_\_** |
| **Date:** |  |  |
| **Place:** |  |  |

## ANNEXURE - 5

#### CHAPTER SCHEME OF THE FINAL REPORT

**Title Page**

##### Acknowledgement (order in which you should acknowledge)

* Head of the Organization where you did your Internship Work
* Your Supervisors
* Other executives/officers of the organization who helped you
* MIT-WPU and the faculty who have helped you
* Others, if any

**Abstract (not more than 500 words)**

#### TABLE OF CONTENTS

Chapter I **INTRODUCTION**

Internship Project: Relevance/background/motivation/objectives/scope etc.

Chapter II **REVIEW OF LITERATURE**

Chapter III **METHODOLOGY / APPROACH**

Sources of Data and Information Variables/Relationships/Models/Hypotheses Tools and Techniques of analysis

Chapter IV **ANALYSIS / RESULTS**

Output/Testing of Hypotheses/Tables Discussion of Results

Chapter V **INTERPRETATION**

Chapter VI **CONCLUSIONS & RECOMMENDATIONS** Chapter VII **SUGGESTIONS FOR FUTURE WORK** Chapter VIII **APPENDICES**

##### Bibliography



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# Internship Logbook



**FACULTY OF**

**ENGINEERING AND TECHNOLOGY**

S. No. 123, MIT-WPU Campus, Paud Road, Kothrud, Pune - 411038. (Maharashtra, India)

Tel.: +91-20-25703400