In research, the proposal will be the initial success, although the real success is uncertain.
RESEARCH

Writing a Winning Research Proposal
Finding Answer to Questions

Solving Problems

Intellectual Exploration in search for the truth

Satisfying The Curiosity of The Mind

Solution
IN RESEARCH, the proposal will be the initial success. Although the real success is uncertainty.

Prof Dr Uda Hashim,
Principle Fellow, Institute of Nano Electronic Engineering
Simple Approach Writing Research Proposal

Research proposal is the first step in research management towards excellence and essential documents to be by-off by the supervisor before start the research activities systematically.

Why we need to produce a good research proposal?
- To start research work and finish on time
- To plan, conduct and monitor research progress systematically
- To success in research with highest impact
- To minimise failure and maximise research impact
- To secure and win research grants

About the Speaker

Prof Dr Uda Hashim is Professor in Microelectronic Engineering and now serves as the Director of the Institute of Nano Electronic Engineering, INEE (UniMAP). He has 15 years research experiences in semiconductor wafer fabrication industry before joining UniMAP in 2003. He is currently a Visiting Professor at UTEM. His research interest are nanobiosensor, nano lab-on-chip, nano chip, microfluidic medical diagnostic using nanotechnology for treating epidemic diseases and cancer at early stage. With over 400 international research publications in Scopus database and total grants secured accumulative to RM 8 Million, he is proudly the recipient of TRSM Award 2014, from Academic Science Malaysian for his accomplishments and contribution in STI agenda of the nation, as well as the recipient of ISESCO Prices for Science and Technology in 2012.
A workshop by experience mentor giving the secret of practical guide in developing research skills essential for researchers. Offers a clear and comprehensive strategy for conceptualizing, approaching and executing the task of writing a research proposal, provide critical and process-oriented approach for working with academic literature. Ultimately, to be a better academic writer yourself!

**Workshop Timetable**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.30 – 10.30 am</td>
<td>How to write a Research Proposal I – Research Problem, Objective, Scope and Milestone</td>
</tr>
<tr>
<td>10.30-11.00 am</td>
<td>Teabreak</td>
</tr>
<tr>
<td>11.00-12.30 noon</td>
<td>How to write Research Proposal II – Step by step guide</td>
</tr>
<tr>
<td>12.30-1.30 pm</td>
<td>Assignment &amp; Coaching session</td>
</tr>
<tr>
<td>1.30pm</td>
<td>End session</td>
</tr>
</tbody>
</table>

**Contact us at:**

Institute of Nano Electronic Engineering (INEE)
Universiti Malaysia Perlis (UniMAP), Block A Taman Pertiwi Indah, Seriab Jalan Kangar-Alor Setar,
01000 Kangar, Perlis MALAYSIA
Website : http://inee.unimap.edu.my/
Email  : uda@unimap.edu.my
Phone no : 04-9798581 / 019-4008844 Fax : 04-9798578
Research Success

through excellent proposal and systematic monitoring

Through step by step guide in producing excellent research proposal and systematic research monitoring, all participants are expected to gain the advance experience on how:

- To start research and complete on time
- To maximise research impact and minimise failure

These experience will lead to:

- Producing high impact publications
- Initiate commercialization process

The ultimate goal is to excel in research beyond expectations!

Learning from Leader’s experience

Join us now! Contact no:

019-4008844

Mentoring Program special for Researchers, Lecturers & Postgraduate Students

About the speaker

Prof Dr Uda Hashim is Professor in Microelectronic Engineering and now serves as the Director of the Institute of Nano Electronic Engineering, INEE (UniMAP). He has 15 years research experiences in semiconductor wafer fabrication industry before joining UniMAP in 2003. He is currently a Visiting Professor at UTEM. His research interest are nanobiosensor, nano lab-on-chip, nano chip, microfluidic medical diagnostic using nanotechnology for treating epidemic diseases and cancer at early stage. With over 400 international research publications in Scopus database and total grants secured accumulative to RM 8 Million, he is proudly the recipient of TRSM Award 2014, from Academic Science Malaysian for his accomplishments and contribution in STI agenda of the nation, as well as the recipient of ISESCO Prices for Science and Technology from OIC in 2012.
Workshop Schedule:

Morning session:
How to write a good research proposal effectively-step by step

Evening session:
How to plan & monitor your research progress systematically – monthly progress report

Contact us at:
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MALAYSIA
Website : http://inee.unimap.edu.my/
Email : uda@unimap.edu.my
Phone no : 04-9798581 /019-4008844
Fax : 04-9798578

Why researchers should join this workshop?

Researchers are the ultimate multitaskers. They have to juggle their grant writing and reviewing responsibilities with keeping up to date with new developments, promoting their research and writing up the results their next research papers- all on top of their day-to-day research tasks.

This puts a lot of pressure on them, particularly if they are just starting out in their academic careers.

Learning how to do each of these things effectively can make a big different.

Thus, this workshop is aim to support researchers and equip them with the skills and knowledge they need to do great research, publish high-impact papers and excel in their academic field.

Don’t miss this golden opportunity! You will not regret it.
How to Write Excellent Research Proposal Effectively – Step by Step
RESEARCH proposal
(Winning Research Proposal)

HIGH IMPACT

RESEARCH Publication
(Publishable Research Paper)
Research – My Experience

INDUSTRY AND ACADEMIA
Research – INDUSTRY

- To solve a problem
- To meet the demand and customer need

Driven by goals for money
Research – ACADEMIA

- PUBLICATION
- STUDENT – MSC/PHD
- Commercialization

Driven by goals for fame and reputation
KEPENTINGAN PROPOSAL
MENENTUKNAN KEJAYAAN AWAL
WALAUPUN
BELUM TENTU
KEJAYAAN HAKIKI
R & D ????
How to Produce EXCELLENT Research Proposal
Why We Need To Produce Excellent Research Proposal?

• To start research work and finish on time
• To conduct research systematically
• To success in research with the highest impact
• To minimize failure
• **To apply and win research grant**

• Is a buy-off between supervisor and student
• Is almost like a research guide / manual
• For research monitoring purposes
• XXXXXXXX
Quality of the Proposal

The measures for a good quality proposal are:

- Informative title;
- Convincing executive summary;
- Clear problem statement;
- Scientific background and rationale;
- Good selection of research methods;
- Ethical considerations; and
- Realistic budget and schedule.
(PRACTICAL TIPS FOR EXCELLENT PROPOSAL)

- Articulates problem accurately
- Provides appropriate background
- Manageable within the time
- Cost-effective
- Linked to defined outcomes
- Clear methodology
- Seen to make a contribution to the field
- Concise writing
- Demonstrates right team approach
- Has credible academic supervision
- Last but not least.....

READ THE GUIDELINES A-Z AND STICK TO THEM
Six Important Elements in Writing a Research Proposal (for Grants Application)
What is a Research Proposal?

• Proposals are *specialized, technical documents that offer persuasive solutions to problems.*

• A proposal also needs to sell the reader on some idea – usually that he/she needs specific goods or services that you can provide.
Type of Proposals

Proposals are generally categorized as informal or formal.

- **Informal proposal** – *generally short documents of limited scope written by an individual* – for approval

- **Formal proposal** – *normally large, comprehensive documents produced by a team of experts on behalf of an organization* – for execution/implementation
Formal and Informal Proposals (Cont.)

- Executive Summary – synopsizes the substance of the proposal – normally for top management to review.
Formal Proposal - Outline

1. Research Title
2. Abstract/Summary and keywords
3. Introduction/Background
4. Research Problem and Rational
5. Research Objective
6. Research Scope
7. Research Methodology
8. Research Schedule
9. Research Milestone
10. Expected Research Finding/Outcome
11. Summary
12. References
13. Appendix
RESEARCH PROPOSAL FLOW
(1) Research Problem
Problem statement

• Look for the real problem
  – Understand the problem
  – Conduct background study
  – Meeting and discuss with end user/affected community
  – Define the problem
  – Type of problems
  – Should be related directly to ……
  – Country/national interest

• It is a real problem?
  – how much/big?
  – Who are affected?- community/national.
  – value - $ and Cent

• Interdisciplinary issues.
• Specific and quantitative

• Problem has to be addressed precisely and concisely.

Research Problem —Focuses on an issue, a problem, a gap in the knowledge of the field.
Research Problem

- **Research Problem** — Focuses on an issue, a problem, a gap in the knowledge of the field.
Where and How to Understand the Problem

- Literature Review
- The End user
- Practitioner
- Survey
- Supervisor
Research Started With Problem
Problem statement - Example
This study is undertaken due to the following rationality as presented below:

3.1. Basal stem rot (BSR) caused by Ganoderma boninense is the most serious disease of oil palm in Malaysia, causing severe economic losses. The control of this fungal disease is largely dependent on visual inspection for Ganoderma specific symptoms that is labor intensive, time consuming, and requires skilled and trained personnel. There is currently no vaccine available as well as no solution for rapid detection of Ganoderma boninense.

3.2. The identification of ganoderma boninense colonies has been based on traditional culturing methods such as PCR (polymerase chain reaction) that require lengthy investigation periods. This study will offer an early detection of the disease. For BSR disease, early detection is particularly important to eliminate differential diagnoses and to start the appropriate treatment as soon as possible without killings of young plants.

3.3. The lack of specificity and many sources of interference occur in the conventional chemical methods, making the process often susceptible to errors, as there are many ganoderma species that appear to be very similar in their culturing conditions. Poly-Si NW biosensor will be applied as a promising tool in biosensor design because of their ultra sensitivity, selectivity, label free and real-time detection capabilities, which solves the problem by opting multiple channels that allow for a separate, multiple detections of leptospirosis and melioidosis diseases.

3.4. In medical microbiology unequivocal identification of ganoderma boninense by conventional biochemical reactions is usually achieved. There is, however, a remarkably high risk of becoming infected while working with living cultures of pathogens ganoderma boninense. In comparison to conventional methods, the use of nanobiosensor allow for rapid identification at reduced risk for infection of laboratory personnel. The speciation part of the laboratory work can then be performed with killed bacteria or the template DNA thereof.

3.5. Although assessment of the environmental load of ganoderma boninense is important for risk assessment in humans or animals in endemic areas, traditional methods of bacterial culture for isolation have low sensitivities, inquire long time incubation for up to two weeks, and are labor-intensive. In comparison to conventional methods, the use of nanobiosensor allows for rapid identification within possibility of within 1 hour for confirmation.

3.6. The conventional detection method such as tissue culture and PCR based analyses are expensive, time-consuming that takes up to two weeks, and are labor-intensive. In comparison to conventional methods, the use of nanobiosensor allows for a rapid, inexpensive, multiple detections of diseases within 1 hour for confirmation, at a very low amount of concentration.

3.7. Currently, assessment of palm oil plantation diagnosed with ganoderma boninense infection requires skilled personnel, special reagents and equipment to conduct the screening process. Therefore, by applying nanowire biosensor and microfluidic channel as Lab-On-Chip module, any staff is able to interpret the data and run analysis of detection of diseases on patients, which saves time and cost and is very convenient.
Problem Encountered
By DNA Lab

• Molecular testing must be performed in a proper laboratory setting
  – To avoid contamination
• Need to have well trained molecular biologist to perform the test
  – To avoid false positive result
• Result interpretation is manual
  – Resulting in error, contamination
• Time consuming
  – Less productivity
(3) Research Title
RESEARCH PROBLEM LEADING TO RESEARCH TOPIC/PROJECT

• Choose a research project/topic that excites you, that you can be passionate about.

• Do background study on the specific area before proposing the real program/project

• Choose the research that leads to the development of a knowledge/technology/materials/products or process.

• Understand national research focus and direction

• Within our expert domain
Research Proposal - Title

• **Title**—Specific description of project.
• Choose a *title* that will attract **attention** – not too textbook like.
• A good title is **self explanatory**
• Type of research title – **Fundamental/Applied**
How to Prepare the Title

• Make a list of the most important **keywords**
• Think of a title that contains these words
• The title could state the conclusion of the paper
• Think, **rethink** of the title before concluded the proposal
Research Title – Fundamental (Example)

**Biological And Electrical Properties Study** Of Heterocyclic Aromatic Amines Using In-house Fabricated Dielectric Nanogap Capacitance Biosensor For Age Related Cancer Diagnostic, Screening And Prevention.

**Preparation and Surface Modification** of Inorganic Nano-Structures for Bio Molecule Probe Immobilization and Hybridization for Label Free Halal Product Detection Kit.

**FUNDAMENTAL STUDY** OF TiO$_2$ NANOWIRE SYNTHESIZED BY SOL-GEL METHOD FOR DNA PROBE IMMOBILIZATION AND DNA TARGET HYBRIDIZATION: THE PHYSICAL AND ELECTRICAL PROPERTIES CHARACTERIZATION.
Research Title
- Applied
Research Proposal Title - Applied

• Make sure does not reflect fundamental
• Able to produce tangible or demonstrate the output/finding
• Leading to prove of concept and not yet reaching prototype level.
• Have potential to move to the prototype research in the next step.
Research Title – Applied (Examples)

– Lung Cancer Volatile Bio-Markers Detection using Novel Architecture of Nanosensor Array

– Exploration of Rapid Method for Detection of "Super-Bug" - Methicillin-resistant Staphylococcus Aureus (MRSA) using Real Time Electronic Nose Technology

– DEVELOPMENT OF PORTABLE FREQUENCY BASED DETECTION SYSTEM USING CMOS-NANOSCALE SURFACE ACOUSTIC WAVE (CMOS-SAW) SENSOR FOR BIOMARKER PATHOGEN DETECTION.


– Investigating the Dielectric Properties of Poultry Meat using ZnO Nano Wire based Biosensor for Halal Authentication: Comparison study between Islamic and non-Islamic slaughtering method
Research Proposal Title
- Prototype
• Avoid to include fundamental related sentences in the objective or scope.
• Already have proof of concept.
• Lab-scale prototype and still not ready for commercialization.
Research Proposal Title – Prototype (Example)

- **MASK ALINGER** FOR MICRO FABRICATION
- Microfluidic **Lab-on-chip** Nanowire Biosensor for Pathogen Sensing
(4) Research Objective
Objective

Complete Solution
Research Proposal - Objective

- Objectives must address the title
- Recommended to have two research objective; general (applied) and specific (fundamental).
  - Extremely important for research student proposal
  - For grant application, suitable for Science Fund, LRGs, ERGS
APPLIED

General Objective

Do What?

For What?

Specific Objective

Study/Understanding

Fundamental

Development / solution
Features/advantages
Application/ problem
Specific/characteristic
Title and Objective

Title

Objective

General

Specific

Applied

Fundamental

Specific
General Research Objective

The aim of this research is to develop *ultra high sensitive* and *selective Nano Lab-On-Chip Medical Diagnostic System* using integrated *Microfluidics* and *silicon nanowires* based transducer for *low concentration* and *single bio-molecule label-free* detection that lead to any related diseases Using in-vitro Clinical samples

**TITLE**

*Development of Microfluidics Nanowire Based Sensor for Low Concentration Biomolecule Detection*
The Specific objectives of this research are:

• To *investigate the effect* of inorganic silicon nanowires at various sizes for sensitivity measurement of the reaction between nanowires and bio-molecule samples.

• To *access the performance* of surface modification of in-organic material (silicon) for better attachment of bio-molecule marker on the inorganic nanostructure surface for immobilization and hybridization process.

• To *study the influence* of microfluidic chamber and tube (inlet and outlet) design and sizes for capillary and flow mechanic effect of bio-molecule sample.

• To *understand the performance* of the proposed integrated PDMS microfluidic with silicon nanowire sensor to function as Nano LAB-On-Chip for smooth delivery of bio-molecule samples to the fabricated nano based tranducer for sensitivity and selectivity detection through electrical measurement.
Title and Objective

Title: [Text]

Objective:
- General
- Applied
- Specific
- Fundamental
Research Scope
Research Scope

• Research scope must deliver the objectives
• Job/work to do in research
  – Explain briefly what to do to meet the objective
  – The detail of the work will be explained in detail in methodology section
• Research scope is just an research activities without time frame.
• Research scope is normally translated to research milestone (job done)
IN- SHORT

Do
What

How
Develop Research Activities Qualitatively
Title, Objective and Scope

General

- Literature review and theoretical study ........
- To design silicon nanogap mask......
- To fabricate and optimize nanogap........
- To inspect and characterize ......
- To extract and produce....
- To prepare DNA immobilization......
- To detect the DNA hybridization....
- To do electrical test on ......

Specific

- To design silicon nanogap mask...
- To fabricate and optimize nanogap......
- To inspect and characterize ......
- To extract and produce....
- To prepare DNA immobilization......
- To detect the DNA hybridization....
- To do electrical test on ......
Research Scope - What?

Research Scopes

- To explore and understand ....... thru Literature Review
- To identify and purchase......
- To prepare sample .........
- To design ......
- To fabricate/conduct and characterize .........
- To setup or prepare .........
- To test and optimize........
This project is embarks based on the following scopes:

- **To explore and understand** thoroughly the principle of conventional size reduction technique, structure technology, nanogap biosensor, DNA immobilization and hybridization detection selectively principle and its electrical characteristic through literature review. This is extremely important for the first step in this development of nanogap biosensor.
- **To design two types of masks** in which the first mask is the lateral nanogap with silicon/polysilicon electrode and the second mask is gold pad electrode mask. Three different numbers of nanogap is proposed which is one, two and three electrodes. These masks will be designed using AutoCAD tool and printed on a high resolution transparence and a chrome glass mask.
- **To fabricate and characterize** an array of nanogap electrode using CMOS conventional size reduction technique. Wet and dry etching process will be utilized to form both lateral nanogap.
- **To characterize and optimize** silicon nanogap, polysilicon nanogap, and gold electrode morphologically and electrically using scanning electron microscopy (SEM), atomic force microscopy (AFM), high power microscope (HPM), transmission electron microscopy (TEM) and current voltage – capacitance voltage (IV-CV) test systems. It is very important step to produce a perfect nanogap structure as narrow as possible in order to detect selectively at these atomic DNA level.
- **To prepare and modify** single-walled carbon nanotubes (SWCNTs) wall surface using functionalized group COOH and followed subsequently exposed to GM1 ganglioside solution for DNA target preparation.
- **To characterize and optimize** functionalized SWCNTs using Fourier Transform Infrared (FT-IR) spectra. It is to make sure the functionalized group is added to the SWCNTs wall and covalently bonded to GM1 ganglioside.
- **To deposit** functionalized SWCNTs bonded with GM1 ganglioside onto nanogap structure for surface modification process.
- **To design and prepare** specific DNA probe for immobilization process.
- **To immobilize** DNA/molecule probe on polysilicon nanogap electrodes. Conductivity and capacitance effect will be tested electrically to detect the immobilization of the samples.
- **To prepare and design** the clinical sample of target DNA for hybridization process.
- **To hybridize** DNA probe and target on nanogap electrodes. Conductivity and capacitance effect will be tested electrically to detect the hybridization of the samples. Different types of clinical samples will be collected and optimize experimental conditions will be determined to ensure the rapid and selectively detection is perfect for all conditions.
Title, Objective and Scope

- Literature review and theoretical study ........
- To design silicon nanogap mask......
- To fabricate and optimize nanogap........
- To inspect and characterize ......
- To extract and produce....
- To prepare DNA immobilization......
- To detect the DNA hybridization....
- To do electrical test on ...
Research Rational
Research Rational

• Asking why, for all the proposed solution.
• From the title, extract and list all the key words.
• Asking why, for all the key words.

Material
Technology
Design
Study
Simple Way to Write Research Rational

• Research Title - DEVELOPMENT OF HIGHLY SENSITIVE AND SELECTIVE CARBON NANOTUBES BASED NANOGAP BIOSENSOR FOR RAPID SCREENING OF VIBRIO CHOLERA.

• Keywords – vibrio Cholerae, Biosensor; carbon nanotubes; gold electrode, nanogap; DNA sensing; functionalization.

• Question should ask – Why Vibrio Cholerae, WHY BIOSENSOR? WHY CNTs? WHY NANOGAP? WHY CNT BASED NANOGAP BIOSENSOR? WHY HIGHLY SENSITIVE AND SELECTIVE?
Research Rational (Example)

RESEARCH RATIONAL

WHY LEPTOSPIROSIS?
- Leptospirosis is a re-emerging zoonotic infection.
- In developing countries large outbreaks have occurred in urban slums and following floods whereas individuals from developed nations are also now more frequently exposed to the infection as a result of international travel and greater participation in certain outdoor recreational activities.
- Leptospirosis remains a diagnostic challenge since it often presents as a non-specific febrile event and laboratory diagnosis is still currently inadequate.
- Rapid tests may not be sufficiently sensitive in early disease and culture facilities are not widely available.
- A severe pulmonary haemorrhagic form of the infection is increasingly being encountered in many countries including Malaysia.
- The control of leptospirosis is largely dependent on general hygienic measures and rodent control.
- An effective human vaccine is still not available and there remains much that is unknown about this disease and there is scope and opportunity for good quality research.

WHY BIOSENSOR?
- Current diagnosis methods for leptospirosis lack sensitivity and specificity and are time consuming.
- Direct microscopic analysis of fresh urine has limitations for it needs relatively large number of leptospires for visualization.
- The serological method of choice is the microscopic agglutination test (MAT), but it fails to detect antibodies during chronic infections or in the early phase of the disease. Although culture techniques can be used to detect leptospires in urine, these procedures are slow, laborious and the samples are susceptible to contamination.
- For the diagnosis of leptospirosis, a rapid and sensitive assay must be able to detect leptospires in blood or urine of infected animals. The polymerase chain reaction (PCR) may fulfill these requirements. In recent years, PCR has been used to detect leptospires and other microorganisms in biological samples like urine (Van Eys et al. 1989, Gernitsen et al. 1991, Meren et al. 1992, Bal et al. 1994, Brown et al. 1995). serum (Merten et al. 1992, Gravekamp et al. 1993, Brown et al. 1995), liquor (Merten et al. 1992, Romero et al. 1998), milk (Zanini et al. 1998), and semen (Mahr et al. 1997).
- The success of PCR depends on the quality of the DNA, that must be free of contaminants and nucleases that impair the amplification process.
- Therefore, the use of biosensor as screening agents means high sensitive and selective sensors, which translates into better access to and detection of Leptospirosis, as well as more powerful and specific signal enhancements, reduced cost, and high through put detection.

WHY CARBON NANOTUBES?
- CNTs are emerging as building blocks of novel nanostructures and devices [29–32]. The large surface per unit mass (60–500m²/g) and excellent mechanical and electrical properties of CNTs make them particularly useful for electronic detection of biomolecules.
- The surface of the CNTs can be functionalized with appropriate chemical groups for attaching desired biomolecules (nucleic acids, enzymes, carbohydrates) or enhancing the solubility or biocompatibility of the tubes [33]. This concept can be exploited for sensor applications where the large surface area of an individual CNT or of a forest of CNTs can be used to immobilize antigen or antibody, which can then be used to capture their corresponding antibody or antigen, respectively.
- In this system, the analyte of interest binds specifically to the complementary biological recognition element immobilized on a suitable support medium. This immunoaffinity reaction can be detected by a change in the mechanical or electrical property of the CNTs.
- Electrochemical sensors can be based on potentiometry, amperometry, voltammetry, coulometry, AC conductivity or capacitance measurements [34,35].

WHY GOLD WIRE BIOSENSOR?
- Gold wire biosensors can be used as a label-free, direct, rapid, sensitive and selective device for detecting biological species.
- The reason why gold was preferred is, Gold is resistant against almost all acids, even hydrochloric acid.
- The notable performance when used in analysis of many ionic species and the extraordinary affinity of thin compounds for its surface make this electrode very suitable for this study taking other application in close proximity in consideration.
- A major goal of nanowire compared to microcantilevers and immunosensor is the efficient detection of single biomolecules, such as the binding (hybridization) between two strands of DNA.
- For biological molecule detection there are two types of methods: label and label-free detection. In label detection a label is attached chemically to the target molecule detecting fluorescence, chem.-luminescence or radioactivity from a label following target-receptor binding. Surface Plasmon resonance (SPR) microcantilevers and carbon Nano-tube electronic devices are examples for label-free approach.
- Many other kinds of molecules, including antibodies, enzymes or proteins, can be identified by specific binding reactions.

WHY MICROFLUIDICS?
- Typically fluids are moved, mixed, separated or otherwise processed. Numerous applications employ passive fluid control techniques like capillary forces. In some applications external actuation means are additionally used for a directed transport of the media. Examples are rotary drives applying centrifugal forces for the fluid transport on the passive chips.
- Active microfluidics refers to the defined manipulation of the working fluid by active (micro) components as micropumps or micro valves.
- Micro pumps supply fluids in a continuous manner or are used for dosing. Micro valves determine the flow direction or the mode of movement of pumped liquids.
- Often processes which are normally carried out in a lab are miniaturized on a single chip in order to enhance efficiency and mobility as well as reducing sample and reagent volumes.
- It is a multidisciplinary field intersecting engineering, physics, chemistry, microtechnology and biotechnology, with practical applications to the design of systems in which small volumes of fluids will be used.

WHY LAB-ON-A-CHIP?
- Lab-On-A-Chip provides many advantages, which are specific to their application. Typical advantages are:
  - Low fluid volumes consumption (less waste, lower reagents costs and less required sample volumes for diagnostics)
  -
Title, Objective and Rational
(6) Research Schedules and Milestones
Research Schedules and Milestones

• **Research Schedules**
  *With timeline*
  When will you start and finish?
  How long will each step take?

• **Research Milestones**
  When the specific job done.
## RESEARCH SCHEDULE

<table>
<thead>
<tr>
<th>No.</th>
<th>Research Work</th>
<th>Schedule Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To do literature review based on studies about the project.</td>
<td>July 2012 - Aug 2012</td>
</tr>
<tr>
<td>2</td>
<td>To experiment on the capillary effect and leakage in Microfluidic channel based on different fluids with analysis software COMSOL MULTIPHYSICS.</td>
<td>Aug 2012 – Sept 2012</td>
</tr>
<tr>
<td>4</td>
<td>To design mask for Microfluidic channel development using AutoCAD tool in which the channel is fabricated on PDMS substrate.</td>
<td>Sept 2012 – Oct 2012</td>
</tr>
<tr>
<td>5</td>
<td>Fabrication and characterization of lateral Nanogap and pad electrode using CMOS conventional size reduction and size expansion technique.</td>
<td>Nov 2012 - Jan 2013</td>
</tr>
<tr>
<td>6</td>
<td>Microfluidic channels are fabricated on PDMS substrate for fluid flow to the individual Nanogaps.</td>
<td>Feb 2013- Mar 2013</td>
</tr>
<tr>
<td>7</td>
<td>Morphological characterization and testing of Microfluidics.</td>
<td>Feb 2013- Mar 2013</td>
</tr>
<tr>
<td>8</td>
<td>Preparation of functionalized SWCNTs with GM1 Ganglioside receptor.</td>
<td>Mar 2013-Apr 2013</td>
</tr>
<tr>
<td>No.</td>
<td>ACTIVITY</td>
<td>END DATE</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>2</td>
<td>Proposal completed</td>
<td>30 August 2012</td>
</tr>
<tr>
<td>3</td>
<td>Design and simulation completed</td>
<td>30 September 2012</td>
</tr>
<tr>
<td>4</td>
<td>Mask design completed</td>
<td>30 October 2012</td>
</tr>
<tr>
<td>5</td>
<td>Nanogap Fabrication completed</td>
<td>30 December 2012</td>
</tr>
<tr>
<td>6</td>
<td>Morphological and electrical Characterization completed</td>
<td>30 January 2013</td>
</tr>
<tr>
<td>7</td>
<td>Microfluidic fabrication completed</td>
<td>28 February 2013</td>
</tr>
<tr>
<td>8</td>
<td>Microfluidic characterization completed</td>
<td>30 March 2013</td>
</tr>
<tr>
<td>9</td>
<td>CNT preparation and deposition completed</td>
<td>30 April 2013</td>
</tr>
<tr>
<td>10</td>
<td>Surface modification</td>
<td>30 May 2013</td>
</tr>
<tr>
<td>11</td>
<td>DNA probe preparation and immobilizations completed</td>
<td>30 June 2013</td>
</tr>
<tr>
<td>12</td>
<td>Lab on chip integration and characterization completed</td>
<td>30 July 2013</td>
</tr>
<tr>
<td>13</td>
<td>DNA target preparation and hybridization completed</td>
<td>30 August 2013</td>
</tr>
<tr>
<td>14</td>
<td>Characterizations and data collections completed</td>
<td>30 September 2013</td>
</tr>
</tbody>
</table>
Research Scopes, Activities and Milestones

- **Research scope**
  - Research Activities or Work

- **Research Schedule**
  - Research Activities with Time Duration (Start & Finish)

- **Research Milestone**
  - Research Activities or Work done with Specific Date
Title, Objective, Scope, Schedule and Milestone

- Literature review and theoretical study
- To design silicon nanogap mask
- To fabricate and optimize nanogap... 
- To inspect and characterize... 
- To extract and produce... 
- To prepare DNA immobilization... 
- To detect the DNA hybridization... 
- To do electrical test on... 
- To design silicon... 
- To fabricate and... 

JOB
DONE

T=4
R=25
S=15
O=35
D=25
I=0

Time duration
(7) Introduction
Introduction

- Background
  A good research background will help one appreciate your problem statement.
  A good literature review write up will show that you have done your homework

- Definition
  Basic theory/fundamental/background of your study
  Previous related study
  History of the research topic
  Major technology/processes/tools involved
(8)
Summary and Abstract
SUMMARY, ABSTRACT

• Abstract
  – Abstract and Keywords — Briefly describe who, what, why and how.
  – Must include brief background, major research rational, important problem statement, general objective, major methodology, expectation.

• Summary
  – Similar to conclusion.
  – Just highlight about your expectation from the research
References
• References
  – Used the latest references.
  – 5 years
Research Methodology
RESEARCH PROPOSAL - PRIORITY

1. Research Title
2. Abstract/Summary and keywords
3. Introduction
4. Research Rational/Problem
5. Research Objective
6. Research Scopes
7. Research Methodology
8. Research Schedule
9. Research Milestones
10. Expected Research Finding/Outcome
11. Summary
12. References
13. Appendix
Research Methodology

• How will you investigate the question? **What** will you do and **how** will you do it?

• Quantitative Activities
Research Methodology

**Equipment/Consumable**
- List of equipment and function
- List of consumable and purposes

**Research Framework**
- Detail Research Flow
- Thinks about plan A and plan B

**Research Activities**
- Research Scopes (Scope of Works)
- Detail research works (quantitative)
Research Methodology

Research Framework
Research Methodology

Develop

All research scopes

Quatitatively
Expected Research Finding /Output
Expected Research Finding/Output

• **Expected Results** — What do you expect to find out?
• Extremely important especially for PRGS grant application.

• Research Proposal for Grant Application
  – Knowledge - new
  – Manpower – student MSc/PhD
  – Paper publications – Journal/Proceeding
  – IP’s – Copy right, patent
  – Products

• **Research Student Proposal**
  – Must related to research objective (general and specific)
Title, Objective and Research Output

Title (General)

Objective (Specific)

Research Output

Applied

Fundamental
Appendix

- Literature review detail
- Process flow details
- Project schedule detail
- etc
Conclusion

OUTLINE OF RESEARCH PROPOSAL

1. Research Title
2. Abstract/Summary and keywords
3. Introduction
4. Research Rational/problem
5. Research Objective
6. Research Scope
7. Research Methodology
8. Research Activities
9. Research Milestone
10. Expected Research Finding/Outcome
11. Summary
12. References
13. Appendix
Conclusion

The success in research with the highest impact begun with the excellent research proposal
Conclusion
(Tips for Excellent Proposal)

• Articulates problem accurately
• Provides appropriate background
• Manageable within the time
• Cost-effective
• Linked to defined outcomes
• Clear methodology
• Seen to make a contribution to the field
• Concise writing
• Demonstrates right team approach
• Has credible academic supervision
• Last but not least.....

READ THE GUIDELINES A-Z AND STICK TO THEM
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