UTeM

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Always A Pioneer, Always Ahead

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FAKULTI KEJURUTERAAN PEMBUATAN

PENYEDIAAN ITEM PENTAKSIRAN

11 APRIL 2022

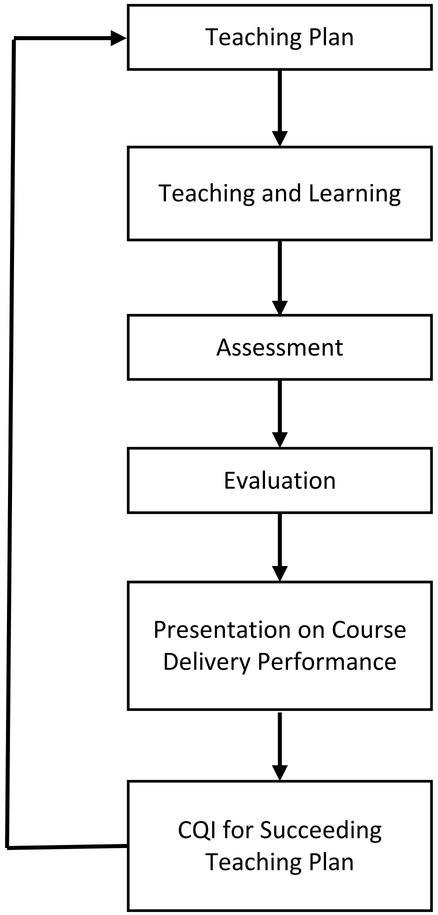
ZAMBERI JAMALUDIN
FAKULTI KEJURUTERAAN PEMBUATAN

MyUTeM

Outlines

- ASSESSMENT
- VETTING

Outcome Based Education (OBE)



Presentation of draft Teaching Plan to TDA, KJ, and Program Coordinator.

With students' evaluation on week 13-15.

In accordance to the assessment strategies outlined in the Teaching Plan as recorded in the OBE system.

Analysis on CLO and subsequently PLO achievement.

Presentation by Course Coordinators to the faculty on achievement of CLO,PLO and proposed CQI actions. Discussion on issues (if any) on effective course delivery.

Proposed CQIs are recorded and become reference for the upcoming course delivery.

ASSESSMENT

- **Asking questions** is a basic way to **gather information**.

- A way to engage "people" in a "**conversation**".

- In education, asking questions are tool in the assessment of students' knowledge on specific topics and subjects.

- Asking the **right questions**, in the **right manner** would ensure that **accurate** and **reliable analyses** and **conclusions** could be extracted from the students based on answers given.

- Responsibility of all lecturers to ensure that measurements of **Course Learning Outcomes** (CLO) are:
  - reliable
  - accurate
  - relevant

- Covid-19 has certainly leaves a great impact on the way that we conduct our assessments.

- Online mode of assessment - integrity

Motivations (Why?)

- All institutions offering engineering programs are faced with significant challenges, especially in preparing students so that they can receive information, learn the technology, the principles and practice of engineering as well as adapting to the rapidly changing needs to compete globally. Criteria and targets set by the Engineering Accreditation Council (EAC) and the Malaysian Qualifications Agency (MQA) stipulate that these students **must be able to process the information actively and critically**, **evaluate them** in order to achieve the high level of professional skills. Apart from the use of teaching and learning strategies, **assessment methods, such as open-ended questions** from the higher level of Bloom's taxonomy can be used to develop the necessary professional skills.

"How to Construct Open Ended Questions", Procedia - Social and Behavioral Sciences 60 (2012) 456 – 462 Hafizah Husain, Badariah Baisb, Aini Hussainb, Salina Abdul Samad

Engineering Accreditation Council
Engineering Technology Accreditation Council
BOARD OF ENGINEERS MALAYSIA

GUIDELINES NO. 005

GUIDING PRINCIPLES ON TEACHING-LEARNING AND ASSESSMENT IMPLEMENTATION DURING COVID-19 PANDEMIC

2.1 All programmes are to ensure the attainment of the 12 Programme Outcomes (POs) as stipulated in the Standards. All alternative assessments must be designed or formulated based on the intended learning outcomes. Scenario or case study types of questions could be used as an alternative to the Psychomotor and Affective POs during the COVID-19 pandemic.

2.2 All programmes are expected to implement substantial equivalent assessments to the pre-pandemic assessments. Continuous assessments implemented could be continued with take-home exams and assignments. The programme is expected to undertake precautionary measures in handling integrity issues.

The teaching-learning and assessment methods shall be appropriate to, consistent with, and support the attainment or achievement of the POs.

For online examination, extra time may be allocated to students to account for the possible unfamiliarity use of the TLA platform or time spent to download and upload assessment documents.

- Continuous assessments may include case study, project-based learning and problem-based learning. Assessments include high taxonomy levels questions where answers are not obtainable directly from textbooks or readily available from the internet to address the characteristics of complex/broadly defined/well defined engineering problems.

So the questions are…

What's best to measure these CLOs?

How do we design the assessments?

MANUFACTURING PROCESSES (DMFM 1323)

Course Learning Outcome

1. Describe the basic principles and operation of common processes in manufacturing.
2. Explain the appropriate machine tool and its ability in producing required part.
3. Apply the principles of machining and manufacturing process in developing a part using learnt processes.
4. Produce a project with engineering values based on the skills acquired.

ENGINEERING MATERIALS (DMFM 1253)

Course Learning Outcome

1. Describe the fundamental principles of engineering materials in terms of its structure.
2. Explain the engineering materials properties based on its structure towards specific performance.
3. Choose suitable processing methods according to their engineering materials structure and properties towards specific performance.

ENGINEERING LABORATORY 3 (BMFP 3111)

Course Learning Outcome

1. Model, simulate and analyze manufacturing systems by using state of the art discrete event simulation software.
2. Perform computer-based simulations and technical report writing on human factors engineering/ ergonomics related to manufacturing industry environment.
3. Work cooperatively with group members, developing teamwork in the assigned activity.

CNC MACHINING (BMFS 4613)

Course Learning Outcome

1. Explain the principle of CNC systems, mechanics and dynamics of machine tool.
2. Analyze CAD/CAM methodology in 2D, 3D, surface modeling and CAM operation.
3. Describe recognizable basic features of Computer Numerical Control (CNC) and CNC Programming.
4. Plan and analyze process planning for part machining.

Closed Ended

- Closed-ended questions are questions that can only be **answered by selecting from a limited number of options**, usually multiple-choice, ‘yes’ or ‘no’, or a rating scale (e.g. from strongly agree to strongly disagree, "Are you satisfied with this product?" → *Yes/No/Mostly/Not quite*).

- They are used to obtain facts and specific pieces of information.

- They do not invite or encourage people to elaborate.

- Standardize responses. Memory-based responses.
- In carefully-written closed questions, the question and responses mean the same thing to nearly all respondents.
- Faster to administer.
- Easier and faster to mark.

Avoid questions that have the following characteristics:

- answers that provide facts
- easy to answer questions
- answers that can be given quickly and require little to no thought.

Open Ended

- Open-ended questions are questions that cannot be answered with a simple ‘yes’ or ‘no’, and instead require the respondent to elaborate on their points.
- **Open-ended questions** start with “why?,” “how?,” and “what if?”
- They require a person to pause, think, and reflect.
- Answers, typically, will not be facts, but personal feelings, opinions, or ideas about a subject
- **Open-ended questions** are broad and can be answered in detail (e.g. "What do you think about this product?"),

- An open-ended question is designed to encourage a full, meaningful and deliberate answer using the subject's own knowledge and/or feelings.
- Ask open-ended questions when you want detailed explanations.
- Open questions enable respondents to answer as they wish.

Features of Open-Ended Questions

Cooney et al (2004) stipulates that open-ended questions should

exhibit the following features:

1. It involves a **significant concept** in a related field. Give students the chance to display their understanding by linking the entire topic and how it can lead to real world problem solving.

2. There could be **multiple answers** to open-ended questions. When a question requires one correct answer, students often conclude there is only one way to solve the problem. Questions that require students to explain their thinking will encourage a variety of responses or reactions because not all students think the same.

4. Need to **communicate the reasoning** process. One strong point of using open-ended questions is that students are given the opportunity to communicate what is in their minds.

5. The question should cause students to think deeper and connect the current question to other ideas previously learned

6. What makes a question “great”?
   - Require more than remembering a fact or reproducing a skill.
   - Students can learn by answering the question, and/or the teacher can learn about the students from how they answer.
   - There are several acceptable solutions (or even answers).

7. Open-ended questions should be **clearly stated**.
   These types of questions should have a clear purpose even if there are many different answers. In addition, students need to know what is expected of them and what lecturers consider as a good and complete response.

Simple examples..

- Why do____________? Explain your answer.
- What are some possible explanations as to why______________?
- Would other _________be affected by ___________? Why or why not?
- How does ___________? Support your answer (with information from reading, from the chart etc.).
- Tell what _____________did wrong. How would you design a better way?
- Explain how you arrived at your answer using pictures, words, equations. (Math)
- Predict and describe _______________. Support and defend your answer.
- Discuss the likelihood that ________________
- From the information on chart, what is true of _________________?

https://www.greeneesc.org/downloads/file_278_2_238.pdf

- Suppose you want to ___________. Make a ________ and ______________. Tell why you chose (included) each.
- If you had to __________, which ____________would you suggest. Explain your answer.
- Make a graph showing ______________. (Math)
- Would you rather have ___________ or ____________? Tell why. (Math)
- What could be done about ____________? Give reasons for your answer
- Compare the ______________. Tell which ______________would be most likely and which ________would be least likely. Support your answer.

Challenges

- Understanding of open-ended questions
- Limitations on existing Course Learning Outcomes that are of low level Bloom Taxonomy
- Greater effort of constructing open-ended questions
- Lengthier time for markings
- Students limited understanding on requirements of open-ended questions

Quality Management: VETTING

- Fulfilling University
  - ISO
  - Academic rules and regulations

- **Our Promise**

Teaching Plan

FACULTY OF MANUFACTURING ENGINEERING
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

CONTROL SYSTEM

BMFA 3313	SEMESTER 2	SESI 2020/2021

1.0 CQI actions to be undertaken this semester

More exposure to understanding and techniques to solve problems through tutorial and in-class exercises have been done. Moreover, additional problems on controller design are introduced through design based laboratory exercises.

2.0 Learning Outcomes

At the end of this course, students should be able to:

LO1 – **Construct** mathematical model of dynamic systems.
LO2 – **Analyze** transient response, steady-state error and stability of first-order and second-order systems.
LO3 – **Design** controllers for complex engineering problems.
LO4 – **Construct** and numerically **validate** a control system using numerical software such as Matlab / Simulink

LO	PO	Taxonomy Blooms	CEPA	Assessment Methods	Assessment Details
LO1	1	C3	WK3	UG	**UG (Q1 & Q2)** – Assess student's ability to represent a system in transfer function and block diagram. **UG (Q2)** – Assess student's ability to construct mathematical model.
LO2	2	C4	WK3	PA	**PA (Q1)** – Assess student's ability to analyze transient response and stability of system. **PA (Q2)** – Assess students' ability to analyze stability and steady state error of a system.
LO3	3	C6	WK3, WP1, EA1	TG1 PA	**TG1** – Assess students' ability to construct a control system. **PA (Q3)** – Assess students' ability to design a controller using root locus. **PA (Q4)** – Assess students' ability to design a controller using frequency response method.
LO4	5	C6	WK3, WP1, EA1	LR1 LR2 LR3	**LR1, LR2 & LR3** – Assess student's ability to construct and numerically validate a control system.

*TG – Assignment, LR – Laboratory, UG – Test, PA – Final examination

3.0 Synopsis

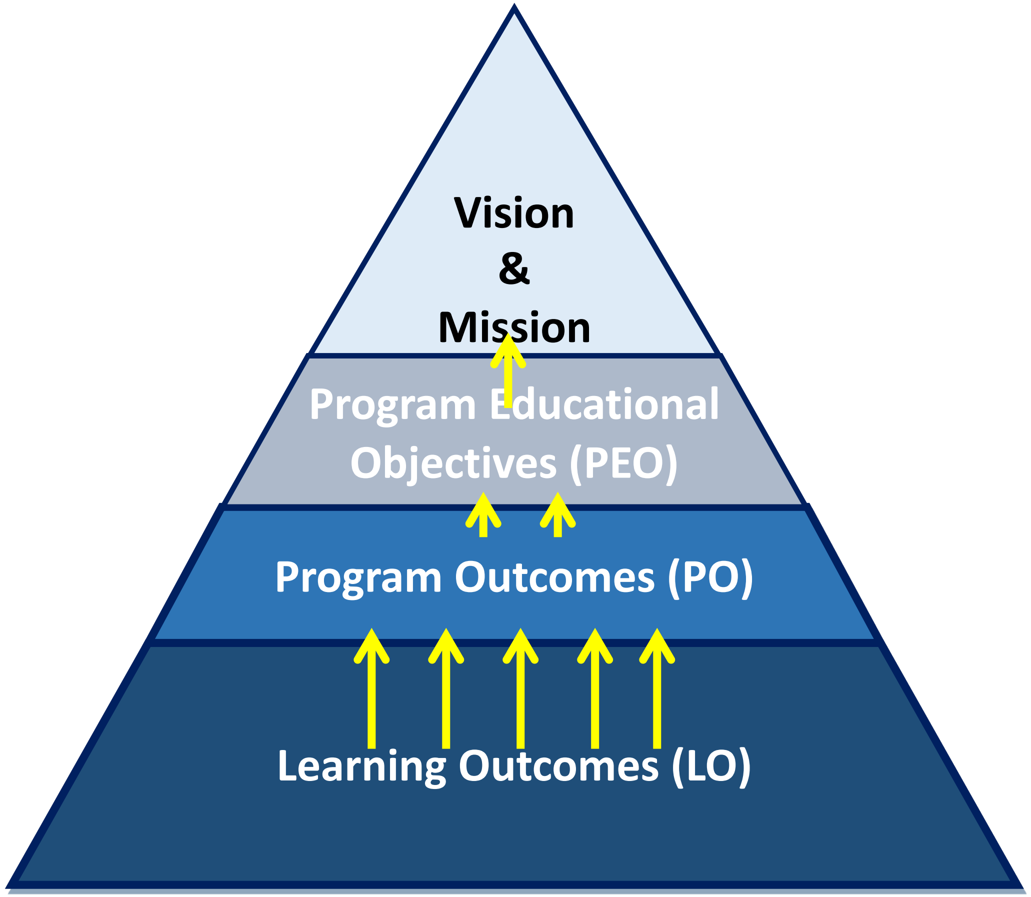
Quality Management: VETTING

- Accreditation Requirement

  - Alignment of Assessment to CLO

  - Fulfilment of Taxonomy requirements

  - Quality Management System

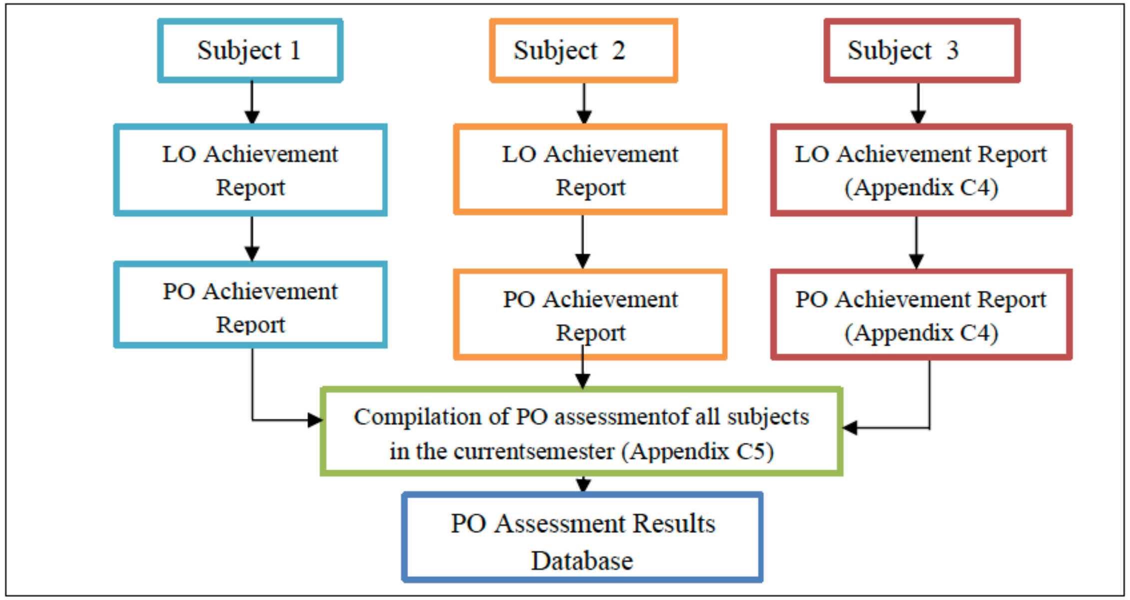


GENERAL PHILOSOPHY

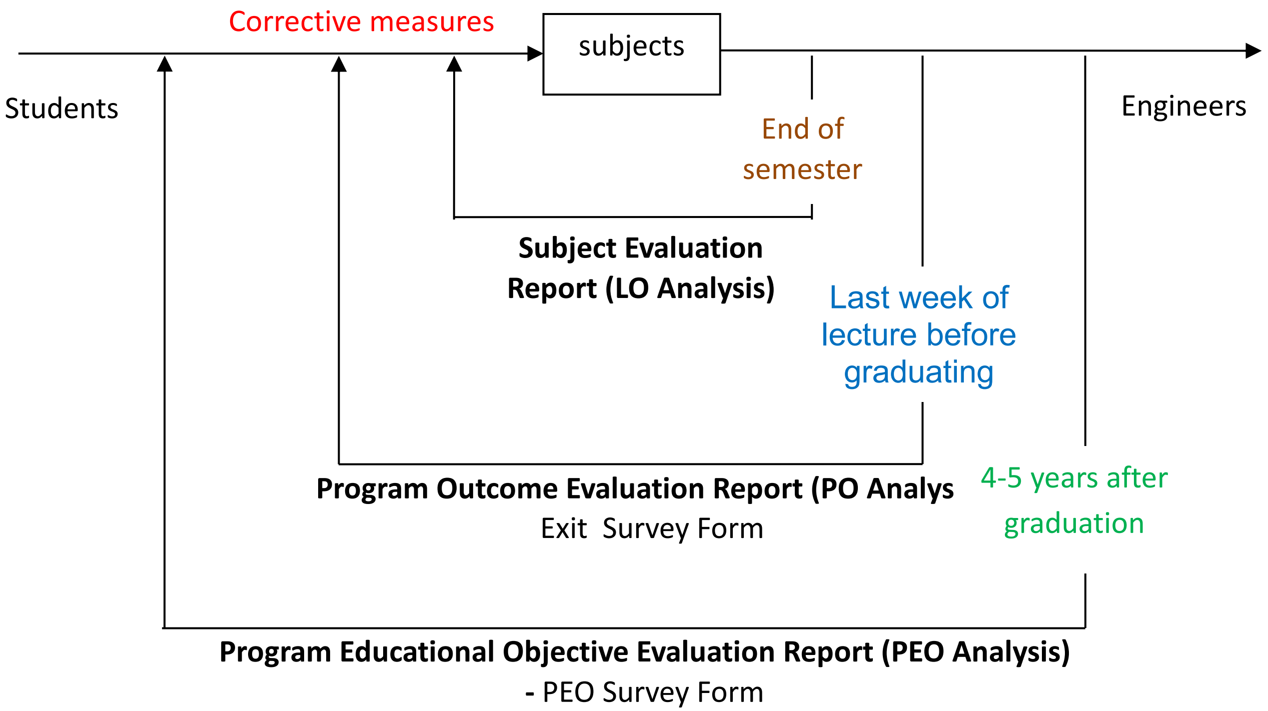
Quality Management: VETTING

Yr	No.	Code	Subject	MatriksKursusLawan PO Fakulti											
				1	2	3	4	5	6	7	8	9	10	11	12
	1	BLHL ***2	Third Language									x			
	2	BLHW 2712	Ethnic Relation		x							x	x		
	3	BMFM 1213	Engineering Mathematics	x											
	4	BMFG 1823	Statics and Strength of Materials	x	x										
	5	BENG 1113	Electric and Electronics Principles	x		x						x			
1	6	BITG 1113	Computer Programming	x	x			x							

Subject	Learning Outcomes	Program Outcomes											
		1	2	3	4	5	6	7	8	9	10	11	12
Lean Six Sigma	LO 1		X										
	LO 2					X							
	LO 3				X								
	LO 4			X									



Quality Management: VETTING



Quality Management: VETTING

COMMON ISSUES IN VETTING

- Wrongful focus
- Inappropriate choice of Taxonomy verbs not reflecting CLO
- Misguided questions
- Mismatch between mark allocation and answer schemes.
- Time allocations appropriateness

3 hours FE ~ 9-11 hours SLT Continuous Assessment
2 hours FE ~ 6-8 hours SLT Continuous Assessment
1 hour FE ~ 3-5 hours SLT Continuous Assessment

- **Alignment of Assessments to CLO**

2.0 Learning Outcomes

At the end of this course, students should be able to:

LO1 – Construct mathematical model of dynamic systems.
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*TG – Assignment, LR – Laboratory, UG – Test, PA – Final examination

Fulfilment of Taxonomy requirements

Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka

TEST BLUEPRINT

CLO, LEVEL OF BLOOM TAXONOMY AND CEPA (WA/DA) TO FINAL EXAMINATION QUESTIONS

Subject Code	BMFS2613	**Session**	2020/21
Subject Name	Manufacturing process	**Semester**	
Prepared by			

Question Number	CLO	BLOOM TAXONOMY (COGNITIVE)	Washington Accord (WA)		Dublin Accord (DA)	
			WP	WK	DK	DP
Question 1	1	C1		WK3		
Question 2	2	C3	WP4	WK8		
Question 3	2	C3	WP4	WK8		
Question 4	3	C3	WP2			

WA = Degree programme (WP/WK)
DA = Diploma programme (DK/DP)

Course Learning Outcomes:

CLO1 - Describe characteristics of manufacturing processes applied in the industry.
CLO2 - Analyze the capability of various manufacturing processes in product development.
CLO3 – Select the most appropriate manufacturing process for a given product design.

Fulfilment of Taxonomy requirements

Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka

LEVEL OF BLOOM TAXONOMY TO FINAL EXAMINATION QUESTIONS

Subject Code	BMFA 3313	**Session**	2017/2018
Subject Name	CONTROL SYSTEM	**Semester**	1
Prepared by	ZAMBERI BIN JAMALUDIN		

Question Number	**LEVEL OF BLOOM TAXONOMY**						
	Level 1 Knowledge	**Level 2 Comprehension**	**Level 3 Applications**	**Level 4 Analysis**	**Level 5 Synthesis**	**Level 6 Evaluation**	**Total**
Question 1			a-i(5), b,c (5)	a-ii,iii(5)			**15**
Question 2			a(4)	b(11)			**15**
Question 3					(15)		**15**
Question 4					(15)		**15**
Question 5					(15)		
Total (%)			**14(19%)**	**16 (21%)**	**45 (60%)**		**75**

Note:
SA – Short answer question
(Marks) [Type of Question]

Learning Outcomes:

i. Construct mathematical model of dynamic systems.
ii. Analyze transient response, stability and steady-state error of first-order and second-order systems
iii. Design controllers for complex engineering problems.
iv. Construct and numerically validate a control system using numerical software such as Matlab/Simulink.

ENGINEERING PROGRAMME ACCREDITATION STANDARD 2020

(v) Describe how the requirements of Complex Problem Solving (CPS) and Complex Engineering Activities (CEA) have been addressed.

The range of **complex problem solving** is defined as follows:

No.	Attribute	**Complex problems** have characteristic WP1 and some or all of WP2 to WP7:
WP1	Depth of Knowledge Required	Cannot be resolved without in-depth engineering knowledge at the level of one or more of WK3, WK4, WK5, WK6 or WK8 which allows a fundamental-based, first principles analytical approach.
WP2	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues.
WP3	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.
WP4	Familiarity of issues	Involve infrequently encountered issues.
WP5	Extent of applicable codes	Are outside problems encompassed by standards and codes of practice for professional engineering.
WP6	Extent of stakeholder involvement and level of conflicting requirements	Involve diverse groups of stakeholders with widely varying needs.
WP7	Interdependence	Are high level problems including many component parts or sub-problems.

ENGINEERING PROGRAMME ACCREDITATION STANDARD 2020

(v) Describe how the requirements of Complex Problem Solving (CPS) and Complex Engineering Activities (CEA) have been addressed.

The range of **complex engineering activities** is defined as follows:

No.	Attribute	**Complex activities** mean (engineering) activities or projects that have some or all of the following characteristics:
EA1	Range of resources	Involve the use of diverse resources (and for this purpose resources includes people, money, equipment, materials, information and technologies).
EA2	Level of interactions	Require resolution of significant problems arising from interactions between wide ranging or conflicting technical, engineering or other issues.
EA3	Innovation	Involve creative use of engineering principles and research-based knowledge in novel
EA4	Consequences to society and the environment	Have significant consequences in a range of contexts, characterised by difficulty of prediction and mitigation.
EA5	Familiarity	Can extend beyond previous experiences by applying principles-based approaches.

ENGINEERING TECHNOLOGY PROGRAMME ACCREDITATION STANDARD 2020

(a) Definition of Broadly-Defined Problem Solving

No.	Attribute	Broadly-defined Engineering Problems have characteristic SP1 and some or all of SP2 to SP7:
1	Depth of Knowledge Required	SP1: Cannot be resolved without engineering knowledge at the level of one or more of SK 4, SK5, and SK6 supported by SK3 with a strong emphasis on the application of developed technology
2	Range of conflicting requirements	SP2: Involve a variety of factors which may impose conflicting constraints
3	Depth of analysis required	SP3: Can be solved by application of well-proven analysis techniques
4	Familiarity of issues	SP4: Belong to families of familiar problems which are solved in well-accepted ways
5	Extent of applicable codes	SP5: May be partially outside those encompassed by standards or codes of practice
6	Extent of stakeholder involvement and level of conflicting requirements	SP6: Involve several groups of stakeholders with differing and occasionally conflicting needs
7	Interdependence	SP7: Are parts of, or systems within complex engineering problems

(b) Range of Engineering Activities

No.	Attribute	Broadly-defined activities
	Preamble	Broadly-defined activities means (engineering) activities or projects that have **some or all** of the following characteristics:
1	Range of resources	TA1: Involve a variety of resources (and for this purposes resources includes people, money, equipment, materials, information and technologies)
2	Level of interactions	TA2: Require resolution of occasional interactions between technical, engineering and other issues, of which few are conflicting
3	Innovation	TA3: Involve the use of new materials, techniques or processes in non-standard ways
4	Consequences to society and the environment	TA4: Have reasonably predictable consequences that are most important locally, but may extend more widely
5	Familiarity	TA5: Require a knowledge of normal operating procedures and processes

THE VETTING PROCESS..

- Vetting Committee

- Vetting form:

  - CLO mapping
  - Level of difficulty
  - Marks allocation, Time Allocation
  - Clarity of Questions
  - Answer scheme

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FACULTY OF MANUFACTURING ENGINEERING

PEER VETTING FORM
FINAL EXAMINATION

Subject Code : BMFS 2613
Subject Name : MANUFACTURING PROCESS
Session/Semester : 2021/2022-1
Vetter : PM DR SHUKOR

A. Course Learning Outcomes: (***section A & B are to be filled by Course Coordinator*****)**

CLO1 - Describe characteristics of manufacturing processes applied in the industry.
CLO2 - Analyze the capability of various manufacturing processes in product development.
CLO3 – Select the most appropriate manufacturing process for a given product design.

B. Mapping and Marks Allocation to Course Learning Outcomes

Questions No.	CLO 1	CLO 2	CLO 3	Recycle No. (Yes)	Recycle track (Latest)
Q1	25				
Q2		25			
Q3		25			
Q4			25		

Kindly rate (√) each question based on the following criteria.
1. Not Appropriate 2. Somewhat Appropriate 3. Appropriate 4. Very Appropriate

QUESTION 1		1	2	3	4	Additional Remarks
i.	Relevance to CLO, Bloom's Taxonomy and WA/DA			√		Please refer to the comments in the question paper.
ii.	Level of difficulty (WA/DA)			√		
iii.	Allocation of time.			√		
iv.	Allocation of marks.			√		
v.	Format and clarity of language.			√		

FKP-Faculty vetting_Feb2020

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FACULTY OF MANUFACTURING ENGINEERING

FACULTY VETTING FORM
FINAL EXAMINATION QUESTIONS

Course Code : BMFS2613
Course Name : Manufacturing Process
Session/Semester : 1 - 2021/2022
Vetter : FKP Management Team & Members of Curriculum, Syllabus and OBE/External Examiner

OVERALL COMMENT

1- Quality of work:

Items	Proficiency	Format
Cover page	1 2 3 4 5	1 2 3 4 5
Q1	1 2 3 4 5	1 2 3 4 5
Q2	1 2 3 4 5	1 2 3 4 5
Q3	1 2 3 4 5	1 2 3 4 5
Q4	1 2 3 4 5	1 2 3 4 5

2 sets of questions

Front page:
Use updated front page

Notes:
1 – Worst 2- Poor 3- Fine 4- Good 5- Excellent

2- Contents

Q1 Explain THREE (3) general precautions.. remove "general" word

BM version
manik kimpalan --> kumai kimpalan
Cadangkan DUA (2) teknik ujian tanpa musnah

All questions are well prepared and follow the CEPA standard.

Signature of Vetter :
(Dean/Deputy Dean(Academic)/Members of FKP Curriculum, Syllabus & OBE)
Stamp : DR. MOHD SANUSI BIN ABDUL AZIZ
Penyelaras BMFG
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka
Date : 21 - 12 - 2021

Signature of Subject's Coordinator:
(acknowledgement of corrections)
Stamp :
Date :

Signature of Head of Department :
(endorsement)
Stamp :
Date :

FKP-Faculty vetting_Feb2020

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FACULTY OF MANUFACTURING ENGINEERING

FACULTY VETTING FORM
FINAL EXAMINATION QUESTIONS

Course Code : BMFR3313
Course Name : Mechanic of Machine
Session/Semester : 1 - 2021/2022
Vetter : FKP Management Team & Members of Curriculum, Syllabus and OBE/External Examiner

OVERALL COMMENT

1- Quality of work:

Items	Proficiency	Format
Cover page	1 2 3 4 5	1 2 3 4 5
Q1	1 2 3 4 5	1 2 3 4 5
Q2	1 2 3 4 5	1 2 3 4 5
Q3	1 2 3 4 5	1 2 3 4 5
Q4	1 2 3 4 5	1 2 3 4 5

Notes:
1 – Worst 2- Poor 3- Fine 4- Good 5- Excellent

2- Contents

Q1 (a) Predict with explanation..
(b) standardize the unit used in sentence; meter --> m

Q3 (b) Find --> Compute
30 per cent --> 30%
(c) add [Note: Use your own word...] at a new line

Q4 Write marks at new line (not in the same line with question)

All questions are well prepared and follow CEPA standard

Set 2

Q3 (a) add unit in Figure 1

Signature of Vetter :
(Dean/Deputy Dean(Academic)/Members of FKP Curriculum, Syllabus & OBE)
Stamp : DR. MOHD SANUSI BIN ABDUL AZIZ
Penyelaras BMFG
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka
Date : 21 - 12 - 2021

Signature of Subject's Coordinator:
(acknowledgement of corrections)
ASSOC. PROF. DR. MD NIZAM BIN ABD RAHMAN
Faculty of Manufacturing Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal, Melaka
Stamp :
Date : 27/12/2021

Signature of Head of Department :
(endorsement)
Stamp :
Date :

(a) A shaft with a 20 mm diameter and a length of 0.6 meter has a rotor with x kg mass at its center and is freely supported on both ends with bearings. The mass of the shaft is negligible and its stiffness is k. During its operation, the shaft will rotate with the attached rotor at the center.

Predict and explain what would happen to the shaft and rotor system if the shaft spins at the angular velocity of $(k/x)^{1/2}$.

(10 marks)

Answer:

The critical angular velocity of the simply supported beam system in rotation is (k/x)1/2 (2 marks)

If the shaft rotates at the critical angular velocity then, (w=wn) (2 marks)

We know that circular frequency,

$$\omega_n = \sqrt{\frac{s}{m}} \quad \text{or} \quad y = \frac{\omega^2 . e}{(\omega_n)^2 - \omega^2}$$

(2 marks)

The deflection, y, will go to infinity due to resonance.(2)

The system will fail. (2 marks)

(b) A vertical double acting steam engine develops 75 kW at 250 rpm. The maximum fluctuation of energy is 30 per cent of the work done per stroke. The maximum and minimum speeds are not to vary more than 1 per cent on either side of the mean speed.

Find the mass of the flywheel required, if the radius of gyration is 0.6 m.

(5 marks)

$\omega = 2\pi N/60 = 2\pi \times 250/60 = 26.18$ rad/s — (1)

$C_s = \frac{\omega_1 - \omega_2}{\omega} = 0.02$ — (1)

work per cycle $= P \times 60/N$

$= 75 \times 10^3 \times 60/250$

$= 18 \times 10^3$ N-m — (1)

ΔE = work $\times C_E$

$= 18 \times 10^3 \times 0.3$

$= 5.4 \times 10^3$ N-m — (1)

$5.4 \times 10^3 = m . k^2 . \omega^2 . C_s = m \times (0.6)^2 \times (26.18)^2 \times 0.02$

$= 4.93\, m$

$m = \frac{5.4 \times 10^3}{4.93}$

$= 1095$ kg. # — (1)

SULIT

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
PEPERIKSAAN AKHIR SEMESTER I
FINAL EXAMINATION SEMESTER I
SESI 2019/2020
SESSION 2019/2020

FAKULTI KEJURUTERAAN PEMBUATAN

KOD KURSUS *COURSE CODE*	:	
KURSUS *COURSE*	:	SISTEM KAWALAN *CONTROL SYSTEMS*
PENYELARAS *COORDINATOR*	:	
PROGRAM *PROGRAMME*	:	BMFG
MASA *TIME*	: :	9.00 PAGI – 12.00 TENGAH HARI *9.00 AM – 12.00 PM*
TEMPOH *DURATION*	: :	3 JAM *3 HOURS*
TARIKH *DATE*	: :	2019 *2019*
TEMPAT *VENUE*	:	DEWAN CANSELOR

ARAHAN KEPADA CALON
INSTRUCTIONS TO CANDIDATES

1. Kertas soalan ini mengandungi EMPAT (4) soalan
   This question paper consists of FOUR (4) questions.
2. Jawab SEMUA soalan.
   Answer ALL questions.
3. Setiap soalan hendaklah dijawab pada muka surat yang baru.
   Use a new page for every question answered.
4. Penyelewengan akademik boleh dikenakan tindakan tatatertib di bawah Kaedah Universiti Teknikal Malaysia Melaka (Tatatertib Pelajar) 2009.
   Academic dishonesty would result in disciplinary action to be taken under Universiti Teknikal Malaysia Melaka (Student Disciplinary) 2009.

KERTAS SOALAN INI TERDIRI DARIPADA (14) MUKA SURAT SAHAJA
THIS QUESTION PAPER CONTAINS (14) PAGES

CONTROL SYSTEMS (BMFA 3313)

Course Learning Outcome

1. Construct mathematical model of dynamic systems.
2. Analyze transient response, steady-state error and stability of first-order and second-order systems.
3. Design controllers for complex engineering problems.
4. Construct and numerically validate a control system using numerical software such as Matlab / Simulink.

(b) A unity feedback system is to be designed to meet the following requirements:

- Specification 1: Forward transfer function

$$G(s) = \frac{K(s+\lambda)}{s(s+\delta)}$$

- Specification 2 : Steady-state position error for a unit ramp input $= \frac{1}{5}$
- Specification 3 : The closed-loop poles locations at $-1 \pm j1$

Determine $K, \lambda,$ and δ to meet the requirements.

(8 marks)

(b) Figure 2 shows a block diagram with a transfer function, *G(s)* as follows:

$$G(s) = \frac{K}{s(s+7)(s+11)}$$

Evaluate the range of gain, *K* for the system to be stable, unstable and marginally stable.

(6 marks)

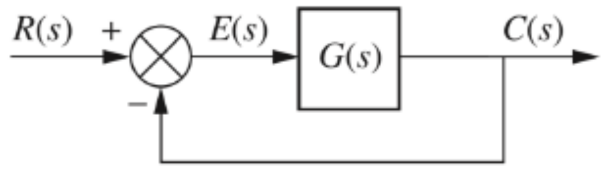

Figure 2: Block diagram of a feedback control system

Q4 Figure 5 shows block diagram of a control system. It represents position control of a CNC milling machine positioning table. A position controller, $G_c(s)$ is to be design fulfilling the following performance criteria:

i. A percentage overshoot of just 5% for a step input.

ii. An improvement of 50% from the current system settling time.

In complex plane, the dominant second order pair of poles for the uncompensated system is located at -3.35 + 3.51j while in frequency domain, the static error constant must equals 40 to meet the steady-state error requirement.

(a) Solve for the gain K that would meet the respective system requirement.

(4 marks)

(b) Design a position controller, $G_c(s)$ that meets the system response requirements using **either a Root Locus method or a Frequency Response method**.
[Note: The open loop Bode diagram of the system is shown in Figure 6]

(12 marks)

(c) Predict the step responses of the compensated system.
[Note: Compare with step response of the uncompensated system]

(4 marks)

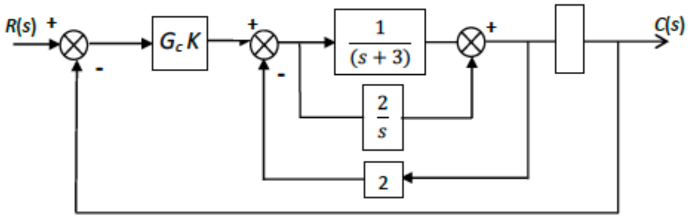

Figure 5: Block diagram of a control system with gain K

CONTROL SYSTEMS (BMFA 3313)

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(b) Figure 2 shows a three degree of freedom positioning robot. A frame is to be located as follows:

$$\begin{bmatrix} 0.527 & -0.574 & 0.628 & a \\ 0.369 & 0.819 & 0.439 & b \\ -0.766 & 0 & 0.643 & c \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Solve for the robot joints parameters including the RPY values.

[Note: Please refer to Appendix 1 for the parameter values a, b, c]

(10 marks)

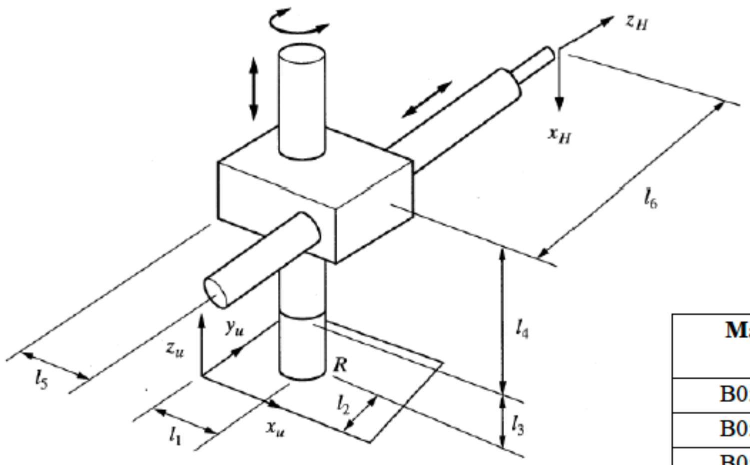


Figure 2: A robot schematic diagram

Course Learning Outcome

1. Explain the components of robots, their structures and applications in manufacturing industry.
2. Explain the role of forward and inverse kinematics in robot arms.
3. Analyze the planned trajectory of a robot arm in a production cell.
4. Devise the motion controls of a robot arm in a production cell.

Appendix 1

Matrix No.	L_1	L_2	L_3	L_4	L_5	*a*	*b*	*c*
B051710119	1	1	1	1	2	23	24	1
B051810031	2	2	2	2	3	22	23	2
B051810002	3	3	3	3	4	21	22	3
B051910091	4	4	4	4	5	20	21	4
B051710206	5	5	5	5	6	19	20	5
B051810053	6	6	6	6	7	18	19	6
B051810061	7	7	7	7	8	17	18	7

Q2 Figure 3 shows an illustration of a 6-degree-of-freedom industrial robot for manufacturing application.

(a) Assign the coordinate systems to each of the robot joints based on Denavit-Hartenberg method.

(6 marks)

(b) Construct the D-H parameters table for this industrial robot.

[Note: Assign appropriate dimensions for each of the link]

(12 marks)

(c) Solve for the transformation matrix between joint 1 and joint 4 at the instant shown in Table 1:

(7 marks)

Table 1: Joint parameters at a particular instant

Joint / Angle	1	2	3	4	5	6
θ_i	10°	15°	10°	5°	20°	10°

Figure 3: An illustration of an industrial robot

Example

Q1 (a) Given the rotational mechanical system of Figure 1, where damper, $D = 1$ and $T(t)$ is a unit step.

Calculate the values of J and K to yield a response of 30% overshoot and a settling time of 4 seconds.

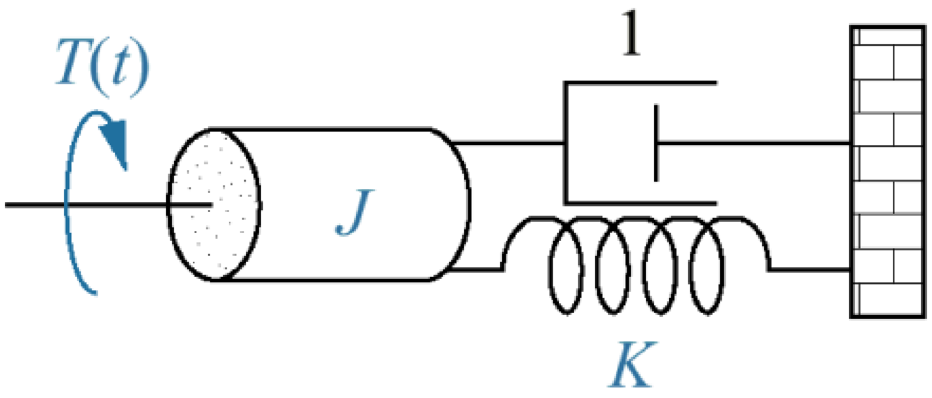


Figure 1: Rotational mechanical system.

Example

A material is needed for the construction of a robotic arm for industrial application. The material to be chosen is the one that shows the smallest amount of elastic deformation.

i. Suggest TWO (2) mechanical properties that must have for the chosen materials.

(2 marks)

ii. Justify your answer in (i).

(4 marks)

Example

Bicycle (bike) come in many forms, each aimed at a particular sector of the market. Consider a design of sprint bikes and a Children's bikes.

i. Identify TWO (2) constraints that must be met for each of the bicycle frame.
(2 marks)

ii. Justify each of the identified constraints in (i).
(4 marks)

iii. Suggest the primary objective of the sprint bikes frame and the children's bike frame.
(2 marks)

iv. Justify your answer in (iii).
(4 marks)

Example

The world today is continuously striving towards carbon neutral clean energy technology. Hence, renewable energy sources like wind power system is increasingly receiving the attention of mankind. Your company is planning to produce a wind turbine electricity generators blades. The blade size should be of 20 to 60 m in length, with complex aerofoil contours, minimum weight, very low maintenance, operated outdoor (expose to sun, rain, hail, storms, heat, cold dust, impact) with expected life time of more than 20 years.

i. Propose the most suitable material for the wind turbine blade.

[Note: Show the materials index performance and design requirement in your answer. Your evaluated candidates should include at least three materials. Appendix I is provided as guidance only, but not limited to.]

(12 marks)

ii. Describe type of construction that you will adopt to produce the blades.

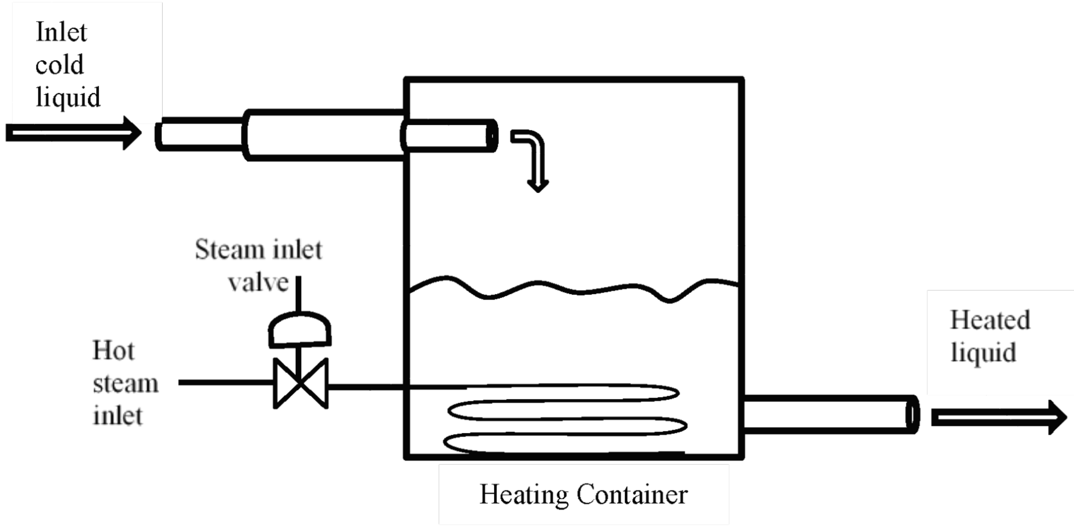
(7 marks)

iii. Sketch the blades design that you will use in (ii).

(4 marks)

Example

Figure 1 shows an example of a heating process control applied in the industry. The inlet cold liquid stream is to be heated to certain temperature before discharges to the next process. A hot steam inlet provides the heating required.



Suggest improvements to the system that would convert the current heating process into closed loop control system.

Note:

- Construct the open loop block diagram.
- Construct the closed loop block diagram of the upgraded system
- Re-sketch the figure and highlight additional elements added.

(10 marks)

Example

Go through your utility bills.

Determine how much money you spent for your refrigerator.

Explain your answer by providing the information below.

i. Details of the Tenaga Nasional Berhad (TNB) utility bills (attach figure)
ii. Specification of the refrigerator and refrigerant (attach figure)
iii. Calculation of the average usage for refrigerator in kWh per day
iv. Calculation of the heat transfer out by the refrigerator in kJ per day
v. Calculation of the energy consumptions by the refrigerator per month
vi. Calculation of amount to be paid for refrigerator per month

(45 marks)

Determine how much your latest bill would be if you had the most efficient refrigeration system installed.

(note: attach the figure and specification of recommended refrigerator)

(10 marks)

Example

- ✓ Pick and application in Manufacturing whereby a specific task (pick-and-place, assembly, polishing, welding etc.) is being handled by a robotic system.
- ✓ Select the best robot configuration (Cartesian, Cylindrical, Spherical, Articulate) for the task selected.
- ✓ Select from literature (not textbook), an industrial-apply robot manipulator suitable for the task and configuration selected.
- ✓ Construct the D-H representative for the robot manipulator selected (indicate/assign all dimensions as necessary with proper labeling).
- ✓ Perform D-H analysis by constructing the DH Parameter Table.
- ✓ Solve for the overall transformation matrix of the robot structure (use any available numerical software to assist you) by assigning numerical values to all respective angles.

Example

Q2 Manufacturing engineer works to locate a center of gravity as a drilled hole location of a thin composite plate with a density is constant. Figure 1 shows the shape of a plate consists of a semicircle with a radius of 10 cm and a square.

(a) Compute an area of the plate using double integral.

(b) Construct a center of gravity using double integral.

(c) Determine M_y if the density of a plate is 0.5 gcm^{-3}.

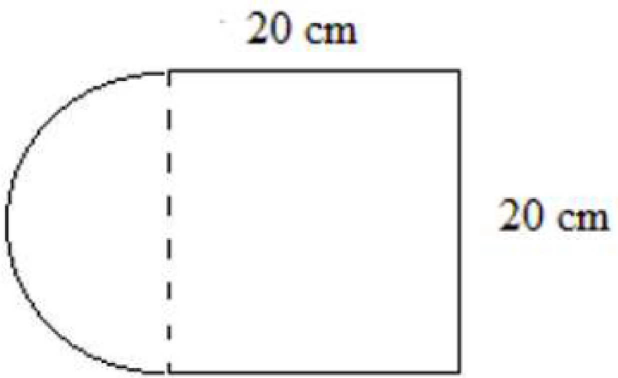


Figure 1: Composite plate

(7 marks)

Example

Q1 (a) Given $f(x,y) = 5x^3 + 2xy - 3x^2\cos(y) + 8$:

i. Classify whether $f_{xy} = f_{yx}$ or otherwise.

(5 marks)

ii. Calculate $f_{xy}(5,2\pi)$ and $f_{yx}(5,2\pi)$ using a result in (i).

(2 marks)

(b) Consider one of the critical points for the function, $f(x,y) = 2xy + \frac{1}{x} + \frac{4}{y}$ is $(\frac{1}{2}, 2)$.

i. Differentiate f_x, f_y, f_{xx}, f_{yy} and f_{xy}.

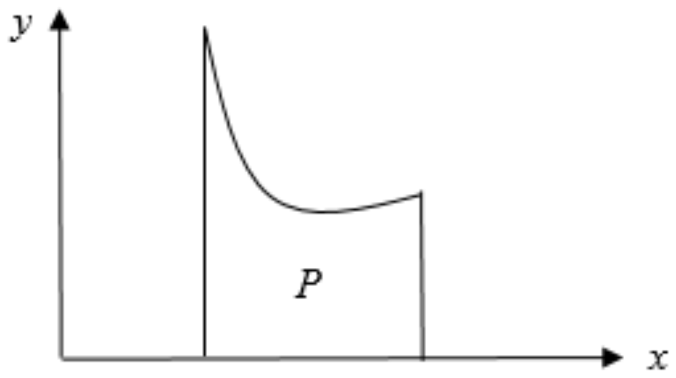
(9 marks)

ii. Compute a value of $f_{xx}(\frac{1}{2}, 2)$, $f_{yy}(\frac{1}{2}, 2)$ and $f_{xy}(\frac{1}{2}, 2)$.

(5 marks)

Example

Luas rantau P yang ditunjukkan di dalam Rajah 3.1 telah dianggarkan menggunakan kaedah berangka dengan satu segmen, iaitu $n = 1$. Tanpa apa-apa pengiraan, kaedah yang mana anda rasa akan memberikan anggaran luas yang lebih baik; petua trapezoid atau petua Simpson's 1/3? Berikan alasan anda.



Example

Anggarkan $\int_0^8 f(x)\,dx$ menggunakan:

i. petua Simpson's 1/3, dengan selang langkah $h = 1$.

(7 markah)

ii. petua Simpson's 3/8, dengan selang langkah $h = 1$.

(7 markah)

iii. Kenalpasti kaedah yang paling baik bagi penyelesaian kamiran tersebut dengan membandingkan keputusan pada (b)(i) dan (b)(ii) dengan nilai sebenar.

[Nota: Diberi nilai sebenar ialah 20.9377]

(2 markah)

Jadual 3

x	0	1	2	3	4	5	6	7	8
$f(x)$	1.8	3.0	3.1	3.0	2.5	2.2	2.7	2.5	3.5

Example

The transient response of this system is to be improved.

Formulate the best strategies that could be applied using classical PID control structure.

(10 marks)

(b) Proportional (P) plus Integral (I) plus Derivative (D) controller (PID) is a form of linear controller. Figure 2 shows a step response of a system.

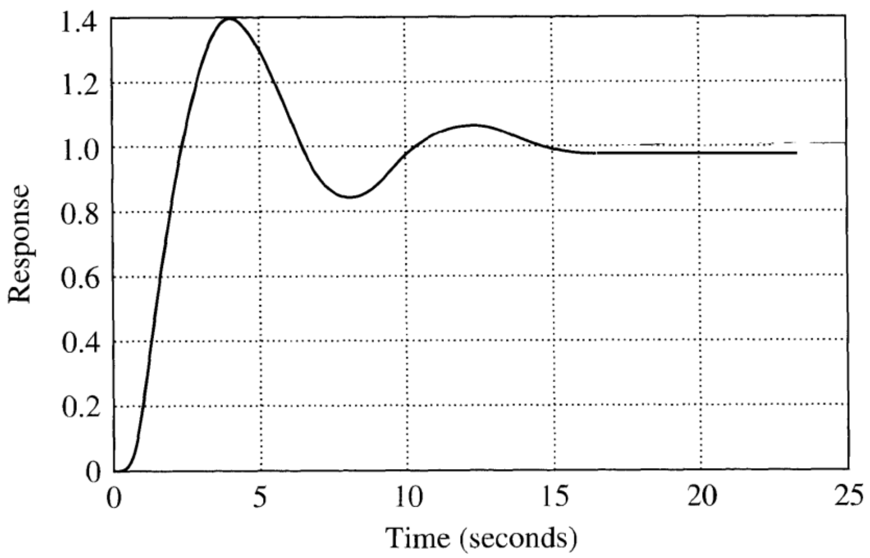


Figure 2: Step response of a PID based control system.

Example

ii. Suggest a change to the system transfer function in term of additional pole or zero on the real axis that would ensure total system stability.
[Note: Re-sketch the revised Root Locus without details as in (i)]

(3 marks)

iv. Predict changes to the system transient response characteristics for the case of increasing the forward gain.
[Note: Considers the followings transient response characteristics; Percentage Overshoot, Settling Time, and Damping Ratio]

(3 marks)

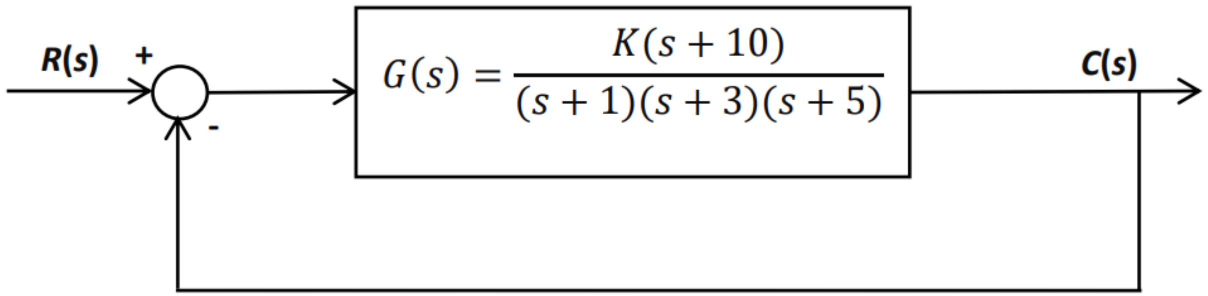


Figure 5: A unity feedback system

Example

Since PLCs were first introduce in 1969, it has evolved tremendously and still considered as the best option a variety of industrial automation applications until this day.
Evaluate the future of PLCs technologies in term of it's features advancement which enable it to stay ahead.

(15 marks)

Makcik Kiyah Group Sdn. Bhd. currently producing bottled fruit juice for local markets and the demand is growing amidst COVID 19 pandemic. The company were unable to meet the increasing demand due to the bottleneck experienced at labelling station as it is manually executed.
Recommend an automated PLC base solution to the problem. Your solution should include;

a. Detail sketch of propose automated bottle labelling station.
b. PLC connection to the system.
c. Descriptions on how your propose solution works.

(25 marks)

Thank You

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