Criteria	Criteria 2- Teaching- Learning and Evaluation
Key Indicator	2.5 - Evaluation Process and Reforms
Metric	2.5.1 - Mechanism of internal/ external assessment is transparent- Question paper and assessment process

The institute conducts internal assessments and question paper as per its SOP.

Guidelines for Internal Assessment (IA)-Question Paper (QP) setting and selection

For technical courses

- Faculty members handling the theory course are required to prepare two sets of QPs as per the IA QP template. Hard copies of the QPs to be submitted to the respective Head of the Department (HoD) one week before the commencement of the IA test.
- HoD along with the program coordinator and module coordinator/senior faculty member shall scrutinize the quality of the QP and approve the same, if the QP is designed as per the pattern specified by the IQAC.
- HoD shall select one QP from the scrutinized QPs for each course on the previous day of IA test, send the selected QP to the EMS coordinator to print the required number of copies of the QP.

For open electives

- Teaching department HoD along with the program coordinator and module coordinator/senior faculty member shall scrutinize the quality of the QP.
- Teaching department HoD has to select one QP from the scrutinized QPs on the previous day of IA test, send the selected QP to the HoD/EMS coordinator of the course opted department to print the required number of copies of the QP.

For II year mathematics

- Mathematics department HoD along with the senior faculty member shall scrutinize the quality of the QP.
- Mathematics department HoD has to select one QP from the scrutinized QPs on the previous day of IA test, send the selected QP to the HoD/EMS coordinator of the technical departments to print the required number of copies of the QP.

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For first year courses

- Teaching department (Technical departments. Mathematics, Physics and Chemistry) HoD along with the program coordinator, module coordinator/senior faculty member shall scrutinize the quality of the QP.
- Teaching department HoD has to select one QP from the scrutinized QPs on the previous day of IA test, send the selected QP to the First year coordinator/EMS coordinator to print the required number of copies of the QP.

For the selected QPs faculty members shall prepare the scheme of evaluation.

The following documents are submitted by the HEI to substantiate the transparence in question paper setting and assessment process,

- Question papers, scheme of evaluation and question paper quality summary sheet – sample evidences.
- Internal assessment /blue book, Assignment book, Quiz/ seminar related documents-sample evidences

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Approved by AICTE, New Delhi & Recognized by Govt. of Karnataka
Vishwothama Nagar, Bantakal - 574115, Udupi District, Karnataka.
SMVITM

MINUTES OF SCRUTINY COMMITTEE MEETING

Date: 24-11-2022

Members:

1. Dr. Soumya J Bhat
2. Ms. Sahana
3. Ms. Savitha Shenoy

Minutes:

1. As per the instructions and the guidelines stipulated by the IQAC all the faculty members have submitted two Question Papers with Scheme of Evaluation.
2. Question Papers were reviewed to check the consistency with respect to taxonomy levels, COs and marks distributions within the choice.
3. The Question Papers with highest overall QP Quality were selected. In case of the same quality a version of Question Paper was randomly selected.
4. Suggestions and comments have been included in the respective Question Papers.

HOD CSE
Sy 24/11/22

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BANTAKAL - 574 115

Head
Dept. of Comp.Science & Engg
SMVITM, BANTAKAL-574115

MINUTES OF SCRUTINY COMMITTEE MEETING

Date: 22-12-2022

Members:

1. Dr. Soumya J Bhat
2. Ms. Sahana
3. Mr. Shrinivas

Minutes:

1. As per the instructions and the guidelines stipulated by the IQAC all the faculty members have submitted two Question Papers with Scheme of Evaluation.
2. Question Papers were reviewed to check the consistency with respect to taxonomy levels, COs and marks distributions within the choice.
3. The Question Papers with highest overall QP Quality were selected. In case of the same quality a version of Question Paper was randomly selected.
4. Suggestions and comments have been included in the respective Question Papers.

HOD, CSE

Sd/- 22/12/22
Head
Dept. of Comp.Science & Engg
SMVITM, BANTAKAL-574115

Sd/-
Principal
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INSTITUTE OF TECHNOLOGY & MANAGEMENT
Vishwothama Nagar, Udupi Dist.
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IA-QP quality summary sheet

I year	Academic Year: 2021-22
IA- III	IA Dates: 27/08/2022 to 30/08/2022

S.No.	Semester	Course code	Course	Course type (Theoretical/Mediocre/ Numerical)	Overall BL	QP version (A/B)
1.	II	21MAT21	Advanced Calculus and Numerical Method	Numerical	3	B
2.	II	21PHY22	Engineering Physics	Medicore	3	A
3.	II	21CHE22	Engineering Chemistry	Theoretical	2	B
4.	II	21ELE23	Basic Electrical Engineering	Medicore	2.35	B
5.	II	21PSP23	C programming for Problem Solving	Mediocre	2.5	A
6.	II	21CIV24	Elements of Civil Engineering and Mechanics	Theoretical/Numerical)	3.0	A
7.	II	21ELN24	Basic Electronics & Communication Engineering	Theoretical	2.6	A
8.	II	21EME25	Elements of Mechanical Engineering	Theoretical	2.6	B
9.	II	21EGH28	Professional writing skills in English	Theory	2	A,B,C,D

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10.	II	21IDT29	Innovation and Design Thinking	Theory	1.2	A,B,C,D
11.	II	21SFH29	Scientific Foundations of Health	Theory	2	A, B, C, D

Veena Kiran 25/8/22
Signature with Date and seal
I BE Programme - Co ordinator
Shri Madhwa Vadiraja Institute
of Technology & Management
Bantakal - 574 115

Veena Kiran 25/8/22
I year Coordinator
I BE Programme - Co ordinator
Shri Madhwa Vadiraja Institute
of Technology & Management
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Principal 25/8/2022

Principal
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IA-QP quality summary sheet

Department: Computer Science and Engineering	Academic Year: 2022-23
IA- II & I	IA Dates: 28, 29 and 30 November 2022

S. No.	Semester	Course code	Course	Course type (*Theoretical/Theoretical numerical/Numerical*)	Overall QP Quality	QP version (A/B)
1	5	18CS51	Management and Entrepreneurship for IT Industry	Theoretical & Numerical	2.00	B
2	5	18CS52	Computer Network and Security	Theoretical	2.65	B
3	5	18CS53	Database Management Systems	Theoretical & Numerical	2.6	B
4	5	18CS54	Automata Theory and Computbilty	Theoretical & Numerical l	2.84	A
5	5	18CS55	Application Development using Python	Theoretical & Numerical	2.73	A
6	5	18CS56	Unix Programming	Theoretical	2.28	A
7	7	18CS71	Artificial Intelligence and Machine Learning	Theoretical & Numerical	2.57	B
8	7	18CS72	Big Data Analytics	Theoretical	2.25	A
9	7	18CS734	User Interface Design	Theoretical	2.6	B
10	7	18CS745	Robotics Process Automation Design and Development	Theoretical	2.28	A

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Sd/- 24/11/22
HoD

Head
Dept. of Comp.Science & Engg.
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Principal

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Vishwothama Nagar, Bantakal - 574115, Udupi District, Karnataka

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IA-QP quality summary sheet

Department: Computer Science and Engineering	Academic Year: 2022-23
IA- III & II	IA Dates: 26, 27 and 28 December 2022

S. No.	Semester	Course code	Course	Course type (*Theoretical/Theoretical numerical/Numerical*)	Overall QP Quality	QP version (A/B)
1	5	18CS52	Computer Network and Security	Theoretical & Numerical	2.484	B
2	5	18CS53	Database Management Systems	Theoretical & Numerical	2.75	B
3	5	18CS54	Automata Theory and Computbilty	Theoretical & Numerical I	2.71	B
4	5	18CS55	Application Development using Python	Theoretical & Numerical	2.782	A
5	5	18CS56	Unix Programming	Theoretical	2.5	A
6	7	18CS71	Artificial Intelligence and Machine Learning	Theoretical & Numerical	2.2	A
7	7	18CS72	Big Data Analytics	Theoretical	2.615	A
8	7	18CS734	User Interface Design	Theoretical	2.5	A
9	7	18CS745	Robotics Process Automation Design and Development	Theoretical	2.135	A

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Sd/-
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IA Moderation team Second Semester (2021-22)

Date: 5-09-2022

Time: 10.30-11.30 **Venue: Board Room**

Sl.No	Subject	Reviewer
1	PHYSICS (21PHY12 /21PHYL26) CHEMISTRY (21CHE22 /21 CHEL26) MATHS (21 MAT21)	Dr. Sudarshan Rao K
2	CIVIL (21 CIV24) BASIC ELECTRICAL (21ELE23/21ELEL27) IDT(21IDT29)	Dr. Ravindra H J
3	CPS (21PSP23 /21CPL27) BASIC ELECTRONICS(21 ELN 24) SFH(21 SFH 29)	Dr. Lolita Priya Castelino
4	MECHANICAL ENGINEERING (21 EME 25) CAED (21 EVNL25) ENGLISH (21 EGH28)	Dr. Reena Kumari P D

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Shri Madhwa Vadiraja Institute
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5/09/2022

I BE COORDINATOR

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BANTAKAL - 574 115

pUSN | | | | | | | | | | |

SHRI MADHWA VADIRAJA INSTITUTE OF TECHNOLOGY & MANAGEMENT, BANTAKAL

Department: Physics	IA- I	Academic Year: 2022-23
Class: G	Course: Applied Physics for ME /CV	Course Code: BPHYM202/ BPHYC202
Date: 10/07/2023	Duration: 1 Hour	Max. Marks: 25

QP Version: A

Note: Answer the following questions

Q.No	Questions	Marks	PI*	BL*	CO*
1a	Explain construction and working of Reddy shock tube	8	1.2.1	L2	CO1
1b	Calculate the peak amplitude of vibration of a system whose natural frequency is 1000Hz when it oscillates in a resistive medium for which the value of damping/unit mass is 0.008 rad/s, under the action of an external periodic force/unit mass of amplitude 5 N/kg, with tunable frequency.	4	2.2.3	L3	CO1
2a	Obtain the expression for equivalent spring constant of two springs which are connected in series and parallel combination.	8	1.2.1	L2	CO1
2b	The Young's modulus for a material is 18×10^{10} N/m^2 and its modulus of rigidity is 8×10^{10} N/m^2 .Determine its bulk modulus for the given material.	4	2.2.3	L3	CO1
3a	Obtain a differential equation for a body undergoing damped oscillation and also explain the cases of Over damping and critical damping with graphical representation.	9	12.1.2	L2	CO1
3b	The time taken by the shock wave to travel the distance of 100mm between the pressure sensors is 200μs. If the velocity of the sound under same condition is 340m/s, calculate Mach number of the shock wave.	4	2.2.3	L3	CO1
4a	Derive the relation between Young's Modulus(Y), Rigidity Modulus (η) and Poisson's Ratio(σ)	9	12.1.2	L2	CO1
4b	A spring undergoes an extension of 5cm for a load of 50gm. Find its frequency of oscillation if it is set for vertical oscillations with a load of 200gm.	4	2.2.3	L3	CO1

BL* Bloom's Taxonomy Level; CO* Course Outcome; PI- Performance Indicator

QP quality

CO	Maximum Marks	Maximum marks		% questions	
		L2 level questions	L3 level questions	L2 level questions	L3 level questions
CO1	9	9	4	0.5	0.5

Overall QP quality = 2 X % of L2 questions + 3 X % of L3 questions

2.5 = 2X 0.5 + 3X 0.5

Prepared By

(Name & signature with date): Usha parvathy 7/7/23

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BANTAKAL - 574 115

Remarks by scrutiny team: Mediocre

Course type (Theoretical/Mediocre/Numerical)

7/7/23

Scrutinized by (Name & signature with date):

QP selected for the test: YES/NO

Head
DEPARTMENT OF PHYSICS
BANTAKAL
7/7/23

HOD Signature with date and seal

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SHRI MADHWA VADIRAJA INSTITUTE OF TECHNOLOGY & MANAGEMENT, BANTAKAL

Department: Physics	IA- I	Academic Year: 2022-23
Class: G	Course: Applied Physics for ME /CV	Course Code: BPHYM202/ BPHYC202
Date: 10/07/2023	Duration: 1 Hour	Max. Marks: 25

QP Version: B

Note: Answer the following questions

Q.No	Questions	Marks	PI*	BL*	CO*
1a	Derive the relation between Young's Modulus(Y), Bulk Modulus (K) and Poisson's Ratio(σ)	8	1.2.1	L2	CO1
1b	The time taken by the shock wave to travel the distance of 250mm between the pressure sensors is 0.5ms. If the velocity of the sound under same condition is 330m/s, calculate mach angle.	4	2.2.3	L3	CO1
2a	Obtain the expression for equivalent spring constant of two springs which are connected in series and parallel combination.	8	1.2.1	L2	CO1
2b	Calculate the Poisson's ratio for silver. Given $Y=7.25X10^{10} N/m^2$ and $K=11X10^{10} N/m^2$	4	2.2.3	L3	CO1
3a	What are damped and forced oscillations? Obtain a differential equation for a body undergoing damped oscillation & mention the expression for the equation of motion.	9	12.1.2	L2	CO1
3b	Calculate the force required to produce an extension of 1mm in a steel wire of length 2m and diameter 1mm. Given Young's modulus of the material is $2X10^{11} N/m^2$	4	2.2.3	L3	CO1
4a	Obtain a differential equation for a body undergoing forced oscillation & mention expression for amplitude & Phase of oscillation. Discuss the three cases for variation of amplitude with frequency in forced oscillation.	9	12.1.2	L2	CO1
4b	Given the force constant as 9.8N/m for a spring, estimate the number of oscillations it would complete in 1 minute if it is set for oscillations with a load of 89.37gm. Assume there are no external forces acting on it.	4	2.2.3	L3	CO1

BL* Bloom's Taxonomy Level; CO* Course Outcome; PI- Performance Indicator

QP quality

CO	Maximum Marks	Maximum marks		% questions	
		L2 level questions	L3 level questions	L2 level questions	L3 level questions
CO1	9	9	4	0.5	0.5

Overall QP quality = 2 X % of L2 questions + 3 X % of L3 questions

2.5 = 2X 0.5 + 3X 0.5

Prepared By

(Name & signature with date): Usha parvathy 7/7/23

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Vishwothama Nagar Udupi Dist.
BANTAKAL - 574 115

Remarks by scrutiny team: Mediocre

Course type (Theoretical/Mediocre/Numerical)

Sandhya 7/7/23

Scrutinized by (Name & signature with date):

QP selected for the test: YES/NO ✓

HOD Signature with date and seal

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Department: Physics	IA- II	Academic Year: 2022-23
Class: G	Course: Applied Physics for ME	Course Code: BPHYM202
Date: 7/08/2023	Duration: 1 Hour	Max. Marks: 25

QP Version: A

Note: Answer the following questions

Q.No	Questions	Marks	PI*	BL*	CO*
1a	Describe the construction and working thermoelectric cooler (TEC).	9	1.2.1	L2	CO2
1b	The thermo *emf* of a *Cu-Fe* thermocouple is *2160µV* when the cold junction is at 0^oC and hot junction at 250^oC. Calculate the constants *a* and *b* if the neutral temperature is 330^oC	4	2.2.3	L3	CO2
2a	Discuss Seebeck effect, and Peltier effect. Explain the variation of thermoelectric emf with temperature and obtain the relation between neutral temperature and inversion temperature.	9	1.2.1	L2	CO2
2b	The e. m. f. in a thermocouple, when one junction of which is at 0^oC, is given by $E = 1600\ T - 4\ T^2$, where T is temperature in ^oC. Find the neutral temperature, peltier coefficient.	4	2.2.3	L3	CO2
3a	Discuss the different types of beams and I-section girder mention their engineering applications	8	12.1.2	L2	CO1
3b	Determine the wave length of X-rays for crystal size of 1.188×10^{-6} m, peak width is 0.5^0 and peak position(θ)15^0, for a cubic crystal. Given Scherrer's constant k=0.92	4	2.2.3	L3	CO4
4a	Explain the construction and working of Atomic Force Microscope (AFM)	8	12.3.2	L2	CO4
4b	A steel wire of 1mm radius is bent in the form of a circular arc of radius 50cm.Calculate the bending moment (Given: Y= $2\text{x}10^{11}$ N/m^2)	4	2.2.3	L3	CO1

BL* Bloom's Taxonomy Level; CO* Course Outcome; PI- Performance Indicator

QP quality

CO	Maximum Marks	Maximum marks		% questions	
		L2 level questions	L3 level questions	L2 level questions	L3 level questions
CO1	8	8	4	0.125	0.125
CO2	9	9	4	0.25	0.25
CO4	8	8	4	0.125	0.125

Overall QP quality = 2 X % of L2 questions + 3 X % of L3 questions

2.5 = 2X 0.5 + 3X 0.5

Prepared By

(Name & signature with date): Usha parvathy 4/8/23

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SHRI MADHWA VADIRAJA INSTITUTE OF TECHNOLOGY & MANAGEMENT
Vishwothama Nagar, Udupi Dist.
BANTAKAL - 574 115

Remarks by scrutiny team: Mediocre

Course type (Theoretical/Mediocre/Numerical)

Scrutinized by (Name & signature with date): Sandhya 4/8/23

QP selected for the test: YES/NO

Head
DEPARTMENT OF PHYSICS
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4/8/23

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Department: Physics	IA- II	Academic Year: 2022-23
Class: G	Course: Applied Physics for ME	Course Code: BPHYM202
Date: 7/08/2023	Duration: 1 Hour	Max. Marks: 25

QP Version: B

Note: Answer the following questions

Q.No	Questions	Marks	PI*	BL*	CO*
1a	Describe the construction and working thermoelectric generator (TEG).	9	1.2.1	L2	CO2
1b	EMF of a thermocouple is 1200μV, when working between 0^oC and 100^oC. Its neutral temperature is 300^oC. Find the values of 'a' and 'b' for it.	4	2.2.3	L3	CO2
2a	Discuss Seebeck effect, and Peltier effect. Explain the variation of thermoelectric emf with temperature and obtain the relation between neutral temperature and inversion temperature.	9	1.2.1	L2	CO2
2b	The e. m. f. in lead – iron thermocouple, one junction of which is at 0^oC, is given by $E = 1784\,T - 2.4\,T^2$, where T is temperature in ^oC. Find the neutral temperature, peltier coefficient.	4	2.2.3	L3	CO2
3a	Derive the expression for bending moment in terms of moment of inertia and hence arrive at the expression for bending moment for a beam for circular and rectangular cross section.	8	12.1.2	L2	CO1
3b	Determine the crystallite size given the Wavelength of X-Rays 10 nm , the Peak Width 0.5 °and peak position(θ)12.5 ° for a cubic crystal given K = 0.94.	4	2.2.3	L3	CO4
4a	Explain the construction and working of Scanning Electron Microscope (SEM)	8	12.3.2	L2	CO4
4b	A steel wire of 1mm radius is bent in the form of a circular arc of radius 50cm.Calculate the bending moment (Given: Y= 2×10^{11} N/m^2)	4	2.2.3	L3	CO1

BL* Bloom's Taxonomy Level; CO* Course Outcome; PI- Performance Indicator

QP quality

CO	Maximum Marks	Maximum marks		% questions	
		L2 level questions	L3 level questions	L2 level questions	L3 level questions
CO1	8	8	4	0.125	0.125
CO2	9	9	4	0.5	0.5
CO4	8	8	4	0.125	0.125

Overall QP quality = 2 X % of L2 questions + 3 X % of L3 questions

2.5 = 2X 0.5 + 3X 0.5

Prepared By

(Name & signature with date): Usha parvathy 4/8/23

Principal
SHRI MADHWA VADIRAJA INSTITUTE OF TECHNOLOGY & MANAGEMENT
Vishwothama Nagar, Udupi Dist.
BANTAKAL - 574 115

Remarks by scrutiny team: Mediocre

Course type (Theoretical/Mediocre/Numerical)

Scrutinized by (Name & signature with date): 4/8/23

QP selected for the test: YES/NO

HOD Signature with date and seal 4/8/23

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SHRI MADHWA VADIRAJA INSTITUTE OF TECHNOLOGY & MANAGEMENT, BANTAKAL

Department: Physics	IA- III	Academic Year: 2022-23
Class: G	Course: Physics for ME Stream	Course Code: BPHYM202
Date: 31/08/23	Duration: 1 Hour	Max. Marks: 25

QP Version: A

Note: Answer the following questions

Qn. No	Questions	Marks	PI*	BL*	CO*
1a	Explain the construction and working of Porous Plug experiment with neat diagram	9	1.2.1	L2	CO3
1b	Calculate inversion temperature of gas. Given: a=0.244 atm L2/mol2, b=0.027 L/mol& R=0.0821 L atm/K/mol.	4	2.2.3	L3	CO3
	OR				
2a	Describe the process of liquefaction of oxygen by cascade process	9	1.2.1	L2	CO3
2b	In Joule Thomson experiment temperature changes from 100^0C to 150^0C for pressure change of 20 Mpa to 170 Mpa. Calculate Joule Thomson coefficient.	4	2.2.3	L3	CO3
3a	Explain the construction and working of X-Ray diffractometer	8	12.3.2	L2	CO4
3b	First order Bragg reflection occurs when a monochromatic beam of X-rays of wavelength $0.675A^0$ is incident on a crystal at a glancing angle of $4^0 51'$. What is the glancing angle for third order Bragg reflection to occur?	4	2.2.3	L3	CO4
	OR				
4a	Explain the construction and working of X-ray photoelectron spectroscopy.	8	12.3.2	L2	CO4
4b	X-rays are diffracted in the first order from a crystal with d spacing 2.8 Å at a glancing angle 60°. Calculate the wavelength of X-rays.	4	2.2.3	L3	CO4

BL* Bloom's Taxonomy Level; CO* Course Outcome; PI- Performance Indicator

QP quality

CO	Maximum Marks	Maximum marks		% questions	
		L2 level questions	L3 level questions	L2 level questions	L3 level questions
CO3	9	9	4	0.25	0.25
CO4	8	8	4	0.25	0.25

Overall QP quality = 2 X % of L2 questions + 3 X % of L3 questions

2.5 = 2X 0.5 + 3X 0.5

Prepared By
(Name & signature with date): Usha parvathy 28/8/23

Principal
SHRI MADHWA VADIRAJA INSTITUTE OF TECHNOLOGY & MANAGEMENT
Vishwothama Nagar, Udupi Dist.
BANTAKAL - 574 115

Remarks by scrutiny team: Mediocre
Course type (Theoretical/Mediocre/Numerical)

Sandhya 28/8/23

Scrutinized by (Name & signature with date):

QP selected for the test: YES/NO ✓

Head, DEPARTMENT OF PHYSICS ... BANTAKAL 28/8/23

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Department: Physics	IA- III	Academic Year: 2022-23
Class: G	Course: Physics for ME Stream	Course Code: BPHYM202
Date: 31/08/23	Duration: 1 Hour	Max. Marks: 25

QP Version: B

Note: Answer the following questions

Qn. No	Questions	Marks	PI*	BL*	CO*
1a	Explain the theory of Joule-Thomson effect.	9	1.2.1	L2	CO3
1b	Calculate inversion temperature of gas. Given: a=0.444 atm L2/mol2, b=0.03L/mol& R=0.093L atm/K/mol.	4	2.2.3	L3	CO3
	OR				
2a	Describe the process of liquefaction of air by Linde's method.	9	1.2.1	L2	CO3
2b	In Joule Thomson experiment temperature changes from 150^0C to 200^0C for pressure change of 30 Mpa to 180 Mpa. Calculate Joule Thomson coefficient.	4	2.2.3	L3	CO3
3a	Explain the construction and working of X-Ray Photoelectron spectroscopy	8	12.3.2	L2	CO4
3b	First order Bragg reflection occurs when a monochromatic beam of X-rays of wavelength $0.8A^0$ is incident on a crystal at a glancing angle of $5^0 30'$. What is the glancing angle for third order Bragg reflection to occur?	4	2.2.3	L3	CO4
	OR				
4a	Explain Nano composites and different types Nano-materials based on the dimensions.	8	12.3.2	L2	CO4
4b	X-rays are diffracted in the first order from a crystal with d spacing 4.8 Å at a glancing angle 80°. Calculate the wavelength of X-rays.	4	2.2.3	L3	CO4

BL* Bloom's Taxonomy Level; CO* Course Outcome; PI- Performance Indicator

QP quality

CO	Maximum Marks	Maximum marks		% questions	
		L2 level questions	L3 level questions	L2 level questions	L3 level questions
CO3	9	9	4	0.25	0.25
CO4	8	8	4	0.25	0.25

Overall QP quality = 2 X % of L2 questions + 3 X % of L3 questions

2.5 = 2X 0.5 + 3X 0.5

Prepared By

(Name & signature with date): Usha parvathy 28/8/23

Remarks by scrutiny team: Mediocre

Course type (Theoretical/Mediocre/Numerical)

Scrutinized by (Name & signature with date): 28/8/23

QP selected for the test: YES/NO

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HOD Signature with date and seal 28/8/23

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Department of Physics

Assignment -I

Last date for submission: 08.07.2023

Question No.	Questions	TLO	CO	MARKS
1	Define Mach number	1.1	CO1	1
2	Define Thermo emf	2.4	CO2	1
3	Define Seeback effect	2.1	CO2	1
4	Obtain differential equation for Simple Harmonic motion	1.4	CO1	3
5	Obtain the expression for equivalent spring constants of Two springs which are connected in series and parallel combination.	1.2	CO1	3
6	Explain the construction and working of Thermocouple.	2.2	CO2	4
7	Calculate the period of oscillation of a mass 0.5Kg if it causes an extension of 0.03m in a spring, if the system is set for vertical oscillations.	1.3	CO1	4
8	The e. m. f. in a thermocouple, when one junction of which is at 0^0 C,is given by	2.3	CO2	3

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Department of Physics

Assignment -II

Last date for submission: 21.08.2023

Question No.	Questions	TLO	CO	MARKS
1	What are Nano-composites?	4.1	CO4	1
2	Define Joule-Thomson effect.	3.1	CO3	1
3	Explain the construction and working of Atomic Force Microscopy (AFM)	4.2	CO4	3
4	Explain the construction and working of Porous plug experiment.	3.2	CO3	5
5	Determine the crystallite size given the Wavelength of X-Rays 10 nm , the Peak Width 0.5 °and peak position 25 ° for a cubic crystal given K = 0.94.	4.3	CO4	5
6	In a Joule Thomson experiment temperature changes from 1000C to 1500C for a change of pressure from 20MPa to 170MPa. Calculate the Joule-Thomson coefficient.	3.3	CO3	5

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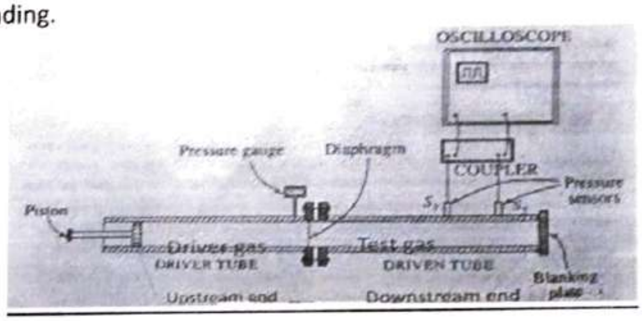
Department: Physics	IA- I	Academic Year: 2022-23
Class: G	Course: Applied Physics for ME /CV	Course Code: BPHYM202/ BPHYC202
Date: 10/07/2023	Duration: 1 Hour	Max. Marks: 25

Scheme of valuation QP Version: A

Q.No	Solution	Mark
1a	Reddy shock tube: Reddy shock tube is hand operated shock tube capable of producing shock waves by human energy. It is a long cylindrical tube with two sections separated by a diaphragm. Its one end is fitted with a piston & the other end is closed or open to the surrounding.  	1Mark
	Description: Reddy tube is consists of a cylindrical stainless steel tube of about 30mm diameter & of length nearly 1 meter. It is divided into two sections each of length 50cm by a aluminium or Mylar or paper diaphragm of thickness 0.1mm. One section is the driver tube & the other one is driven tube. The far end of driven section is fitted with a piston, where as the far end of the driven section is closed. • A digital pressure gauge is mounted in the driven section next to the diaphragm. • Two piezoelectric sensors S_1, S_2 are mounted 70mm apart towards the closed end of the shock tube. • A part is provided at the closed end of driven section for filling the test gas to the required pressure. • The driven section is filled with a gas termed as the driver gas which is held at a relatively high pressure due to the compressing action of the piston. The gas in the driven section is termed as driven gas. Working: The driver gas is compressed by pushing the piston hard in to the driver tube until the diaphragm ruptures. Now the driver gas rushes in to the driven section & pushes the driven gas toward the far downstream end. This generates a moving shock wave that traverses the length of the driven section. The shock wave instantaneously raises the temperature & pressure of the driven gas as shock wave moves over it. The propagating primary shock wave is reflected from the downstream end. After the reflection the test gas undergoes further compression which boosts its temperature & pressure to still higher values by the reflected shock waves. This state of high values of pressure & temperature is sustained at the downstream end until an expansion wave reflected from	3 Mark

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Scheme of valuation QP Version: A

the upstream end of the driven tube arrives there & neutralises the compression partially .Expansion waves are created at the instant the diaphragm is ruptured & they travel in a direction opposite to that of the shock wave. The pressure rise caused by the primary shock waves also the reflected shock wave are sensed as signals by the sensors S_1 & S_2 respectively & they are recorded in a digital cathode ray oscilloscope. From the recording in the CRO, the shock arrived time are found out by associated time base calculations. Using the data so obtained, Mach number, pressure & temps can be calculated. — 4 Mark

1b

Amplitude $a_{max} = \frac{F/m}{2b\omega}$ — 1 Mark

$= \frac{5}{2x0.004x\ 2\pi x\ 1000}$ — 2 Mark

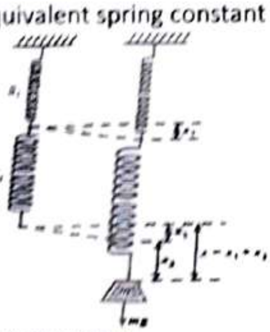
$=0.1\text{m}$ — 1Marks

2a

Force constant- It is defined as the magnitude of applied force that produces unit extension (or compression) in the spring when it is loaded within the elastic limit.\

Equivalent spring constant of springs connected in series combination:

If the mass connected to a spring consists of two or more different springs then the equivalent spring constant or stiffness factor can be calculated as follows. — 1 Mark



SPRINGS IN SERIES

Let the spring constant of spring S_1 and S_2 be K_1 and K_2 respectively and increase in the length of springs S_1 be x_1 and that of S_2 be x_2.

If x is the total increase in the length of the spring system because of mass m, then we have $x= x_1+ x_2$ ....(1) — 3 Marks

Now the same weight cause the elongation in each spring,

$\therefore$ mg= K_1x_1 and mg= K_2x_2

$\therefore x_1=\frac{mg}{K_1}$ and $x_2=\frac{mg}{K_2}$

If K_s is the equivalent stiffness factor (spring constant) of the combination, then

mg= K_sx

Or $\frac{mg}{K_s} = x$ ....(2)

Substituting the value of x, from equation (1) in (2) we get

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Scheme of valuation QP Version: A

2b	$\eta = \frac{Y}{2(1+\sigma)}$	1 Mark
	$\sigma = \frac{Y}{2\eta} - 1$ $= \frac{18\,X10^{10}}{2x\,8\,X10^{10}} - 1$ $= 0.125$	1 Marks
	$K = \frac{Y}{3(1-2\sigma)}$	1 Mark
	$K = \frac{18\,X10^{10}}{3(1-2X\,0.125)}$ $= 8\,X10^{10}\ N/m^2$	1 Mark
3a	**Damped oscillations:** **Damped oscillation is defined as the oscillation, in which if the amplitude of oscillation keeps on decreasing because of resistive force acting on the body and hence the oscillations die out after some time.** The resistive force (or frictional force or damping force) is proportional to the velocity of the body, but opposite in direction. **Example:** 1. Mechanical oscillation of simple pendulum 2. A swing left free to oscillate after being pushed once 3. Electrical oscillations in an LCR circuit **Expression for the period and amplitude of damped harmonic motion :** Consider a body of mass m executing vibrations in a resistive medium. The vibrations are damped due to the resistance offered by the medium. Under this situation the forces acting on the body are 1. Restoring force which is proportional to displacement but oppositely directed. This can be written as –kx Where k – force constant , x- displacement	1 mark

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$\frac{mg}{K_s} = \frac{mg}{K_1} + \frac{mg}{K_2}$

Or $\frac{1}{K_s} = \frac{1}{K_1} + \frac{1}{K_2}$

For this combination of mass- spring system, the period of oscillation will be,

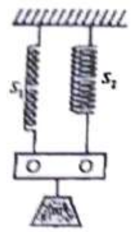
$T = 2\pi\sqrt{\frac{m}{K_s}}$

Thus if a number of springs of different spring constant are connected in series then the equivalent spring constant is given by,

$\frac{1}{K_s} = \frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_3} + \ldots\ldots\ldots\ldots$

Equivalent spring constant of springs connected in parallel combination:

Consider two springs S_1 and S_2 are connected in parallel as shown in figure. Each spring wil share the total load and will have equal elongation say x,



SPRNG IN PARALLEL

1 Mark

If K_1 and K_2 are the spring constant for springs S_1 and S_2 and K_P be the equivalent spring constant for the combination.

Total restoring force $F_P = mg = K_P x$

Restoring force in spring S_1, $F_1 = K_1 x$

Restoring force in spring S_2, $F_2 = K_2 x$

∴ The total restoring force (F_P) = Restoring force in spring S_1 + Restoring force in spring S_2

i.e $F_P = F_1 + F_2$

$K_P x = K_1 x + K_2 x$

∴ $K_P = K_1 + K_2$

Thus the equivalent spring constant of springs connected in parallel combination is the sum of individual spring constants.

3 Marks

For this combination of mass- spring system, the period of oscillation will be,

$T = 2\pi\sqrt{\frac{m}{K_p}}$

Thus if a number of springs of different spring constant are connected in parallel then the equivalent spring constant is given by,

$K_P = K_1 + K_2 + K_3 + \ldots\ldots\ldots\ldots\ldots\ldots$

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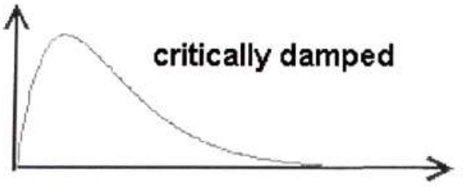
Department: Physics	IA- I	Academic Year: 2022-23
Class: G	Course: Applied Physics for ME /CV	Course Code: BPHYM202/ BPHYC202
Date: 10/07/2023	Duration: 1 Hour	Max. Marks: 25

Scheme of valuation QP Version: A

	the factor (p+qt) but at the same time reversal occurs due to the term e^{-bt} and the displacement approaches to zero as t increases. In this case the particle tends to acquire its position of equilibrium more rapidly than the over damping case. Such oscillations are called critically damped oscillations. The displacement – time graph of critically damped oscillation can be represented as,  Example: 1. Movement of spring- mass system in shock absorber 2. Movement of pointer, in pointer instruments such as voltmeter ammeter etc .	2 Marks
3b	$U = \frac{d}{t}$ =100mm/200μm =500m/s Mach number $M = \frac{U}{a}$ =500/340 =1.47	1 Marks 1 Marks 1 Marks 1 Marks
4a	Hooke's law states that stress is directly proportional to strain with in the elastic limit. **Relation between Young's modulus (Y), Rigidity modulus (η) and Poisson's ratio(σ):** Consider a cube of length L under the action of the tangential stress T. The cube gets deformed to a rhombus with A'P'SD as its one of the face as shown in fig.	

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Scheme of valuation QP Version: A

2. A resistive force force which is proportional to the velocity but oppositely directed, which can be written as –rv

Where r- damping constant, v- velocity of the body — 2 Marks

Hence the resultant force acting on the body = -kx-rv ....(1)

But from the Newton's second law of motion we know that,

Resultant force acting on the body $F=ma= m\frac{d^2x}{dt^2}$ ....(2)

From (1) and (2) we can write,

$m\frac{d^2x}{dt^2}$ = -kx-rv

$m\frac{d^2x}{dt^2} = -kx - r\frac{dx}{dt}$

$m\frac{d^2x}{dt^2} + r\frac{dx}{dt} + kx = 0$

$\frac{d^2x}{dt^2} + \frac{r}{m}\frac{dx}{dt} + \frac{k}{m}x = 0$

$\frac{d^2x}{dt^2} + 2b\frac{dx}{dt} + \omega^2 x = 0$ ....(3)

Where $2b = \frac{r}{m}$ and $\omega^2 = \frac{k}{m}$

This is the equation of motion for damped oscillation.

The general solution of equation (3) will be of the form, — 2 Marks

$X=A_1 e^{(-b+\sqrt{b^2-\omega^2})t} + A_2 e^{(-b-\sqrt{b^2-\omega^2})t}$ ....(4)

Where A_1 and A_2 are arbitrary constants.

Depending upon the relative values of b and ω we can study the following 3 cases

Case I : When $b^2>\omega^2$ - Over damping

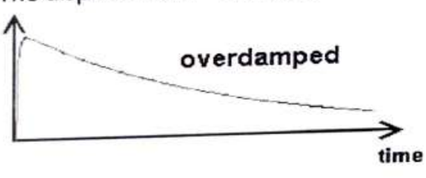
If $b^2>\omega^2$ then $\sqrt{b^2-\omega^2}$ is real and less than b.

Then $(-b+\sqrt{b^2-\omega^2})t$ and $(-b-\sqrt{b^2-\omega^2})t$ are negative in equation (4)

Hence the displacement x, will reduce exponentially to zero, without performing any oscillations. This type of oscillation is called as over damped.

Example: Pendulum moving in a thick oil.

The displacement – time graph of over damped oscillation can be represented as, — 2 Marks



Case II : When $b^2=\omega^2$ – Critical damping

For the case Critical damping the equation(4) will take the form $X = e^{-bt}$ [p+qt]

Where p= $A_1 + A_2$ and q = $\sqrt{b^2-\omega^2}$) ($A_1 - A_2$)

From this equation, it is clear that as t increases, the factor (p+qt) also increases but the factor e^{-bt} decreases. Therefore the displacement 'x' increases in the beginning due to

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Class: G	Course: Applied Physics for ME /CV	Course Code: BPHYM202/ BPHYC202
Date: 10/07/2023	Duration: 1 Hour	Max. Marks: 25

Scheme of valuation QP Version: A

	$\eta = \frac{Y}{2(1+\sigma)}$	2 Marks
4b	Force constant, $k=F/x$ $=mg/x=(50x10^{-3}x9.8)/(5x10^{-2})=9.8N/m$ $\omega= km$ $=[9.8/(200x10^{-3})]^{1/2}$ =7rad/s $\nu=\omega/2\pi=1.11Hz$	1Mark 1Mark 1Mark 1Mark

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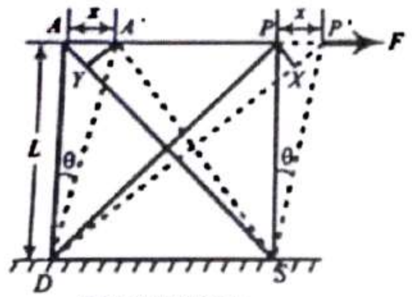
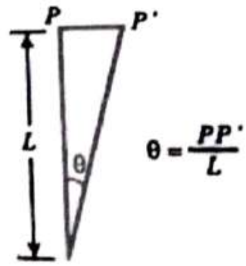
Department: Physics	IA- I	Academic Year: 2022-23
Class: G	Course: Applied Physics for ME /CV	Course Code: BPHYM202/ BPHYC202
Date: 10/07/2023	Duration: 1 Hour	Max. Marks: 25

Scheme of valuation QP Version: A



DEFORMATION



SHEARING ANGLE

1 Mark

The diagonal AS undergoes a contraction and the diagonal DP undergoes an elongation of equal amount.

The tangential stress T is equivalent to a compressive stress T along PS and tensile stress along the diagonal DP. These compressive and tensile stress together produce extension along the diagonal DP.

2 Marks

If α is longitudinal strain per unit stress and β is the lateral strain per unit stress,
The strain produced along the diagonal DP due to tensile stress is equal = T. α
The strain produced along the diagonal DP due to compressive stress is equal = T . β

∴ Total strain along DP $= T(\alpha+\beta) = \frac{P'X}{DP}$ ....(1)

We know that the diagonal DP= $\sqrt{2}$ L

2 Marks

And P'X= PP' cos $45^0 = \frac{PP'}{\sqrt{2}} = \frac{x}{\sqrt{2}}$

Substituting the above values of P'X and DP in equation (1) we get,

Total strain along DP = $T(\alpha+\beta) = \frac{x}{2L}$

$$T(\alpha+\beta) = \frac{\theta}{2}$$

$$\frac{T}{\theta} = \frac{1}{2(\alpha+\beta)}$$

2 Marks

$$\eta = \frac{1}{2(\alpha+\beta)} \qquad \left(\text{since } \frac{T}{\theta} = \eta\right)$$

This equation can be written as ,

$$\eta = \frac{\frac{1}{\alpha}}{2(1+\beta/\alpha)}$$

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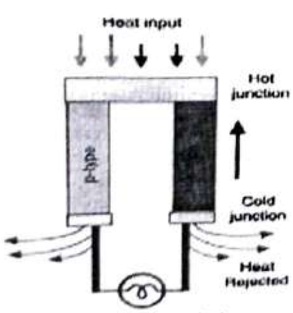
Date: 7/08/2023	Duration: 1 Hour	Max. Marks: 25
Scheme of valuation and solutions QP Version: B		

1a	**Thermoelectric generators (TEG):** Thermoelectric is the name which is the combination of words electric and thermo. So, the name signifies that thermal corresponds to heat energy and electricity corresponds to electrical energy. And thermoelectric generators are the devices that are implemented in the conversion of the temperature difference that is generated between the two sections into the electrical form of energy. This is the basic thermoelectric generator definition. These devices are dependent on the thermoelectric effects which involve interface that happens between heat flow and the electricity through solid components. Principle: The Seebeck effect forms the basis for power generation. Thermoelectric generators convert heat energy to electricity. When a temperature gradient is created across the thermoelectric device, a DC voltage develops across the terminals. When a load is properly connected, electrical current flows. Typical applications for this technology include providing power for remote telecommunication, navigations, and petroleum installations. Construction: The simplest thermoelectric generator consists of a thermocouple, comprising a p-type and n-type thermo-element connected electrically in series and thermally in parallel (Fig).The P-type and N-type semiconductors are interconnected through a metal. Load is connected to free end of P and N type semiconductors.To design such thermoelectric generators, semiconductors are used which have high electrical conductivity and low thermal conductivity.  	1Mark 3Mark 1Mark

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<table>
<tr><td></td><td>Working:

Heat is pumped into one side of the couple and rejected from the opposite side. The electrons present at the hot end would be at a high energy level as compared to electrons present at the cool end side. This means that the hot electrons will tend to move towards the cool end due to the temperature gradient. When a temperature gradient is produced between two ends, the electrons start flowing from one end to another end and create a potential difference. An electrical current is produced, proportional to the temperature gradient between the hot and cold junctions.

Of the great number of materials studied, semiconductors based on bismuth telluride, lead telluride and silicon-germanium alloys are found to be the best.</td><td>4 Mark</td></tr>
<tr><td>1b</td><td>$e = at + 1/2bt^2$

$T_{n} = -\frac{a}{b}$

$-300 = \frac{a}{b}$

$a = -300\ b$ ....(1)

$1200 \times 10^{-6} = at + \frac{1}{2}bt^2$

$1200 \times 10^{-6} = -300b \times 100 + \frac{1}{2}b\ 100^2$

$12 \times 10^{-6} = -250b$

$b = \frac{12 \times 10^{-6}}{-250} = -4.8 \times 10^{-8}$

$\therefore a = 300 \times -4.8 \times 10^{-8}$
$a = 14.4 \times 10^{-6}$</td><td>1Mark

1Mark

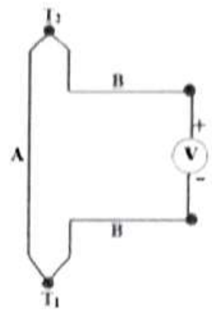
1 Mark

1Mark</td></tr>
</table>

2a **Seebeck effect:**

Definition: The production of electromotive force (emf) and hence current by maintaining the junctions of two dissimilar metals at different temperatures is called Seebeck effect.

In 1821 Thomas Johann Seebeck discovered this phenomenon. The emf is known as thermoelectric emf. The thermoelectric emf causes a continuous current in the conductors, if they form a complete loop and the current is known as thermo electric current. The voltage (thermo electric emf) created is of the order of several micro volts per kelvin difference. 3Mark



The thermo electric emf will exist and the current will flow in the circuit as long as the 2 junctions, known as the "hot" junction and "cold" junction, are at different temperatures. Thus, the Seebeck effect is the conversion of temperature differences directly into electricity. The magnitude and direction of thermoelectric current depends on the types of metals used and the temperature between the hot and cold ends. It does not depend on the temperature distribution along the conductors.

The voltage developed in the circuit, is proportional to the temperature difference between the 2 junctions.

$V = (T_2 - T_1)$ Where $\alpha = \alpha_B - \alpha_A$

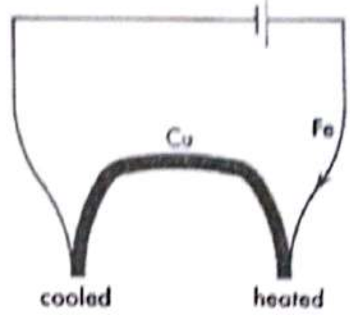
α_A *and* α_B are known as the Seebeck coefficients of the metals A and B,

and T_1 and T_2 are the temperatures of the two junctions.

Seebeck effect is observed not only in metals but as well in semiconductors also. It is not necessarily a junction phenomenon, but arises in a single conductor also. If temperature gradient (difference) is caused in conductor, electrons diffuse from the hot side to the cold side. Electrons migrating to the cold side leave behind their oppositely charge and immobile nuclei on the hot side and thus give rise to a thermoelectric voltage.

Peltier effect:

In 1834 Peltier discovered that when electric current passed in a circuit consisting of two dissimilar metals, heat is evolved at one junction and absorbed at the other junction. This is known as peltier effect. It is the inverse of the Seebeck effect. The peltier effect is junction phenomenon. There is heat absorption or generation at the junctions depending on the direction of current flow. Heat generated by current flowing in one direction was absorbed if the current was reversed.

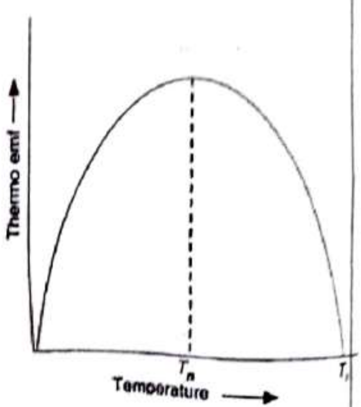


3Mark

As an example, consider the circuit as shown in the figure. Under these conditions it is observed, as indicated in the diagram, that the right-handjunction is heated, showing that electrical energy is being transformed into heat energy. Meanwhile, heat energy is transformed into electrical energy at the left junction, there by causing it to be cooled. When the current is reversed, heat is absorbed at the right junction and produced at the left one.

Variation of Thermoelectric emf with temperature:

If the temperature of the cold junction of athermo couple is kept at 0°C and the thermo electric e.m.f. 'e' is plotted against the temperature T of the hot junction, we obtain a parabolic curve, as shown in Fig. It is seen that the thermo e.m.f. increases with the temperature of the hot junction and becomes a maximum at a particular temperature, T_n. T_n is known as the **neutral temperature** which is a constant for the given pair of metals forming the thermocouple. The temperature of the hot junction at which maximum thermo e.m.f. flows is a constant for a given couple and is known as neutral temperature T_n for that couple.



3Mark

If the temperatureof the hot junction is increased beyond the neutral temperature, the e.m.f.decreases and becomes zero at a temperature T_i, known as the inversion temperature. The temperature at which the thermo e.m.f. is zero, is known as inversion temperature. Beyond the temperature of inversion, the e.m.f. again increases but in the reverse direction.

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	The thermo e.m.f. varies with temperature according to the following relation. $e = at + 1/2bt^2$ ------ (1) where a and b are Seebeck constants for the thermo couple, Eqn.1 is known as Seebeck equation, and $t = T_i - T_n$ Differentiation of eqn.(1) gives $\frac{de}{dT} = a + bt$------- (2) At $T = T_n$, e is maximum and hence $\frac{de}{dT} = 0$. Therefore $0 = a + bT_n$ $T_{n} = -\frac{a}{b}$ --------(3) At $T = T_i$, e = 0. Therefore, it follows from equation (1) that $0 = aT_i + 1/2\, bT_i^2$ OR $T_i\,(a + \frac{1}{2} bT_i) = 0$ Therefore $T_i = -2a/b$----------(4) From equation (3) & (4) we get $T_i = 2T_n$	
2b	$e = at + 1/2bt^2$. $E = 1784\,T - 2.4\,T^2$ $T_{n} = -\frac{a}{b}$ $T_n = \frac{1784}{-4.8} = -371.66$ Peltier coefficient $\pi = T\frac{de}{dT}$ $= T\,(1784 - 2.4X2T)$ $= 1784T - 4.8\,T^2$	1 Mark 1 Mark 1 Mark 1 Mark
3a	**Expression for Bending moment of a beam:** Consider a uniform beam whose one end is fixed to a rigid support. If a load is attached to the beam, the beam bends. The successive layers are now strained. A layer like AB which is above the neutral surface will be elongated to A'B' and the one like EF below neutral surface will be contracted to E'F'. CD is neutral surface which	1 Mark

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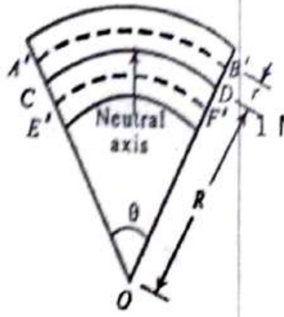
does not change its length.

Let R be the radius of curvature of the beam and θ is the angle subtended by it at the center of curvature.



PART OF BENT BEAM

1 Mark

$\therefore$ Length of CD=Rθ

where 'θ' is the common angle subtended by the layers at common center O of the circles. The layer AB has been elongated to A'B'.

$\therefore$ Change in length =A'B'-AB

But AB=CD=Rθ 1 Mark

If the successive layers are separated by a distance r then,

$$A'B'=(R+r)\theta$$

$\therefore$ Change in length=$(R+r)\theta - R\theta = r\theta$

But original length = AB=Rθ 1 Mark

$$\therefore \text{Linear strain} = \frac{r\theta}{R\theta} = \frac{r}{R}$$

Youngs Modulus Y= Longitudinal stress/linear strain

Longitudinal stress = Y x Linear strain

$$= Y \times \frac{r}{R} \quad \text{........(1)}$$ 1 Mark

$$\text{But stress} = \frac{F}{a} \quad \text{.............(2)}$$

Where F is the force acting on the beam and a is the area of the layer AB.

On equating (1) and (2) we get,

$$\frac{F}{a} = \frac{Yr}{R} = \frac{Yar}{R}$$

Moment of this force about the neutral axis=F x its distance from neutral axis. 1 Mark

$$= F \times r = Yar^2/R$$

Moment of force acting on the entire beam = $\Sigma \frac{Yar^2}{R}$

$$=\frac{Y}{R}\sum ar^2$$

Σar^2 is called the geometric moment of Inertia Ig. $\therefore \Sigma ar^2 = Ig$

$$\boxed{\text{Moment of force} = \frac{Y}{R} Ig}$$

$$\therefore \text{Bending moment} = \frac{Y}{R} Ig$$

1 Mark

The term YI_g is known as flexural rigidity of the beam, which is defined as bending moment of the beam for unit radius of curvature.

For a rectangular beam of breadth 'b', and thickness 'd'

$$Ig = \frac{\text{bd3}}{12}$$

Therefore bending moment of the rectangular bar beam= $\frac{Yb}{12} d^3$

1 Mark

For a beam of circular cross section of radius r, $Ig = \frac{\pi r^4}{4}$

Therefore bending moment for a beam of circular cross section= $\frac{Y\pi r^4}{4R}$

3b

Given: λ=10 nm, $\beta = 0.5^0 = 8.722 \times 10^{-3}$ radian , $2\theta = 25^0$, $\theta = 12.5^0$, K=0.94

1 Mark

$$\mathbf{D} = \frac{K\lambda}{\beta \cos \theta}$$

2 Mark

$$= \frac{0.94 \times 10 \times 10^{-9}}{8.722 \times 10^{-3} \cos 12.5^0}$$

$$= \mathbf{1.103 \times 10^{-6}\ m}$$

1 Mark

4 a

Scanning Electron Microscope(SEM)

Principle: The principle used in the working of a scanning electron microscope is the wave nature of electrons. An electron accelerated under potential difference of V volts behave like a wave of wavelength

$$\lambda = \frac{h}{\sqrt{2meV}} = \frac{1.226}{\sqrt{V}} nm$$

Construction: The apparatus consists of an highly evacuated chamber in which there is an electro gun at the top which comprises of filament & the anode. There are two magnetic lenses, one is condenser lens C & the other one is the objective lens O. A scan coil accompanies the lens O. There is a spray aperture using which spherical aberration during focusing will be minimised. A flat surface called stage is provided at the bottom portion of the apparatus to place the specimen under study. Three detectors are used to detect back scattered electrons. Secondary electrons & X-rays.

3 Marks

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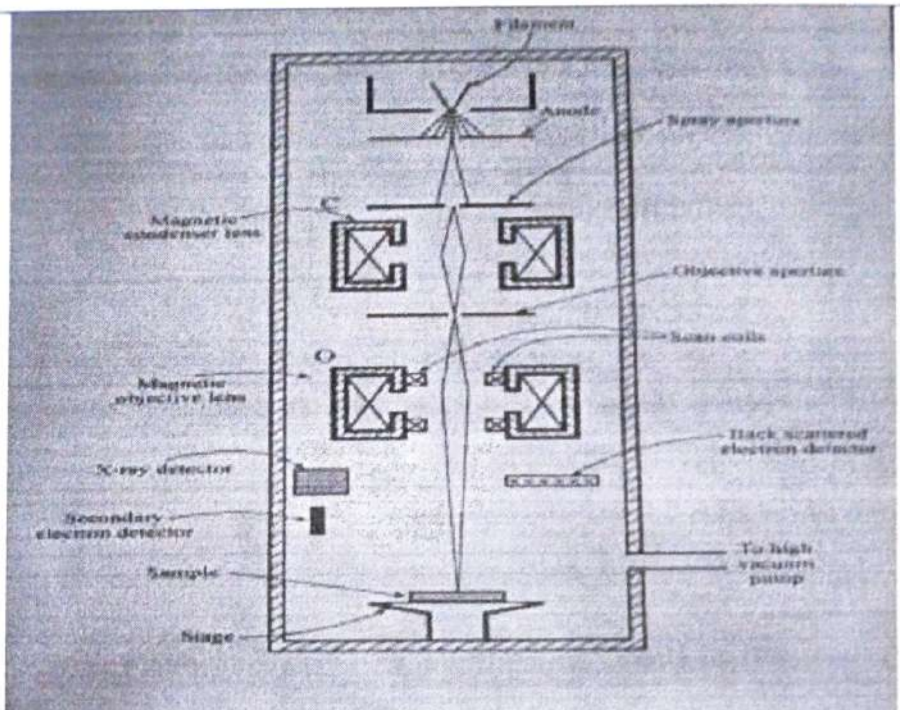

SCANNING ELECTRON MICROSCOPE (SEM)

1 Mark

Working:

A sample to be investigated is placed on the stage in the evacuated chamber. Electrons are emitted by the filament by thermionic emission. A suitable positive potential is applied to the anode with respect to the filament. The accelerated electrons from the electron gun pass through the spray aperture. The condensing lens C converges the beam in to a fine beam. The beam then passes through the objective aperture where the size of the beam can be controlled. The objective lens focuses this beam onto the desired part of the specimen. A set of coils called scan coils placed along with the objective lens, enable the beam to scan the specimen in a particular way.

When the high energy electron beam strikes the specimen, some electrons are scattered due to elastic scattering(back scattered electrons), some electrons are knocked out from the specimen surface (secondary electrons) & some electrons penetrate deep into inner shells of the specimen atoms to knock out inner shell electrons due to which characteristic X – rays are produced. These are detected using respective detectors & the signal is amplified & displayed on a screen which resembles the one in a television.

4 Marks

Applications:

Scanning electron microscope is used to study –

- External morphology of biological organisms.
- Chemical composition of the sample.
- Crystalline structure.

Advantages:

- It can be used to examine specimens of large thickness
- It has large depth of focus
- 3 dimensional image can be obtained

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	• 3×10^5 times magnification can be obtained **Disadvantages:** • Poor resolution	
4b	Bending moment $=\frac{Y}{R}\pi r^4$ $=\frac{2x10^{11}}{50\,x\,10^{-2}}\pi(1x\,10^{-3})^4$ =0.314 N/m	1 Mark 2 Mark 1 Mark

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Department: Physics	IA- III	Academic Year: 2022-23
Class: G	Course: Applied Physics for ME	Course Code: BPHYM202
Date: 31/08/2023	Duration: 1 Hour	Max. Marks: 25

Scheme of valuation and solutions QP Version: A

1a

Porous Plug experiment

Construction:

Joule in collaboration with Thomson [Lord Kelvin] devised a very sensitive technique known as Porous Plug experiment. The experiment set up of porous plug experiment to study the Joule-Thomson effect is shown in Fig.2.1. It consists of the following main parts:

(a) A Porous plug having two perforated -brass discs D & D_1. 3Mark

(b) The space between D & D_1 is placed with cotton wool or silk fibers.

(c) The porous plug is fitted in a cylindrical box-wood W which is surrounded by a vesselcontaining cotton wool. This is to avoid loss or gain of heat from the surroundings.

(d) T_1 &T_2 are two sensitive platinum resistance thermometers and they measure the temperatures of the incoming and outgoing gas.

The gas is compressed to a high pressure with the help of piston P and it is placed through a spiral tube immersed in water bath maintained at a constant temperature. If thereis any heating of the gas due to compression, this heat is absorbed by the circulating water in the water bath

1Mark

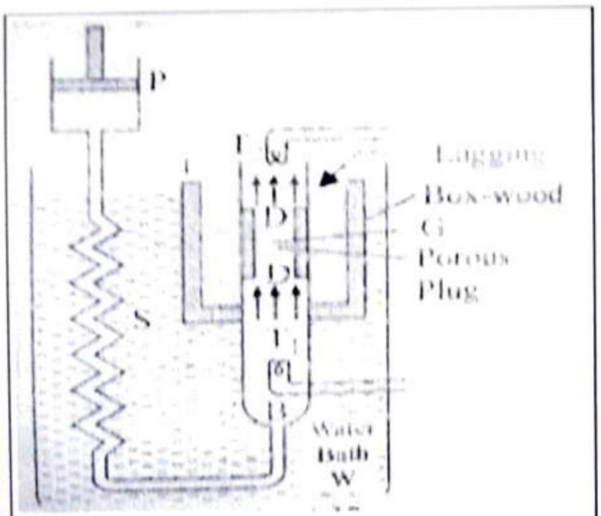

Fig.2.1

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Experimental Procedure

The experimental gas is compressed by Pump P and is passed slowly and uniformly through the porous plug keeping the high pressure constant read by pressure gauge. During the passage through the porous plug, the gas is throttled. The separation between themolecules increases. By passing through the porous plug, the volume of the gas increases against the atmospheric pressure. As there is no loss or gain of heat during the whole process, the expansion of the gas takes place adiabatically. The initial and final temperaturesare noted by platinum resistance thermometers T_1 & T_2. 3Mark

Experimental Results

2Mark

A simple arrangement of porous plug experiment is shown in Fig.2.2 .The behavior of large number of gases was studied at various inlet temperatures of the gas and the results are as follows:

(1) At sufficiently low temperatures, all gases show a cooling effect.

(2) At ordinary temperatures, all gases except hydrogen and helium show cooling effect.
Hydrogen and Helium show heating effect.

(3) The fall in temperature is directly proportional to the difference in pressure on the two sides of porous plug.

(4) The fall in temperature for a given difference with rise in the initial temperature of the gas. It was found that the cooling effect decreased with the increase of initial temperature and becomes zero at a certain temperature and at a temperature higher than the temperature instead of cooling heating was observed. This particular temperature at which the Joule – Thomson effect changes sign is called temperature of inversion.

1b	$T_i=\frac{2a}{Rb}$	1Mark
	$=\frac{2x\ 0.244}{0.0821x0.027}$	2Mark
	=220.14 K	1Mark

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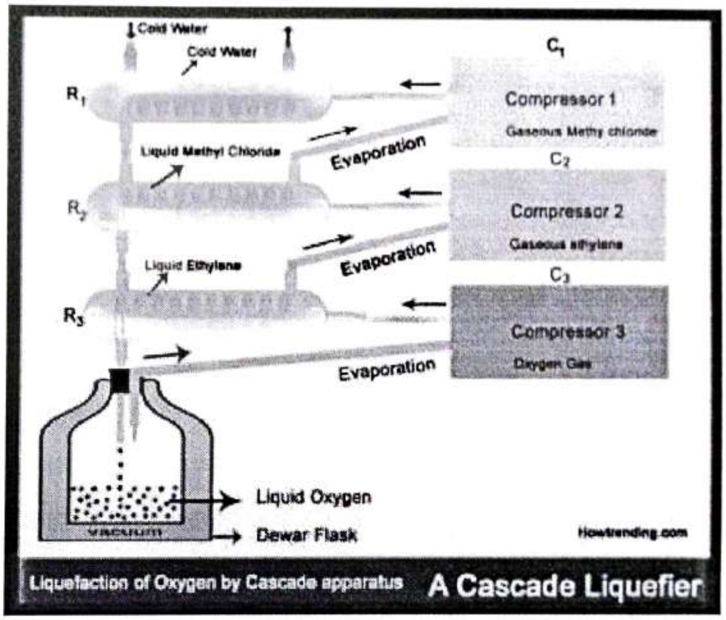
2a

Liquefaction of Oxygen gas by cascade process (Pictet process):

This process was first used by **Pictet** in 1878. He successfully obtained a small quantity ofLiquid Oxygen with the help of pressure applied, and with other liquefied gases.

Cascade system or Process: A process is called the Cascade process, When a single stage isnot enough to produce the desired result, therefore the process takes place in a number of stages in a sequence.



Liquefaction of Oxygen by Cascade apparatus **A Cascade Liquefier**

1Mark

Construction:

4 Mark

1. In this apparatus, three compressors C_1, C_2, C_3 are used to fulfill the requirement of sufficient pressure. Also, the C_1, C_2, and C_3 have a suction side which is used during theprocess.

2. Three condensers R_1, R_2, R_3 are used, into which three refrigerants cold water, Methylchloride, and ethylene are used to get the desired result.

3. The Liquid oxygen is collected in the last, into a Dewar flask.

Principle: This apparatus work on two principles.

1. The first, Principle, compression of gases below its critical temperature resulting in achange to liquid.

2. The second is, producing cooling by the principle of evaporation of liquids.

Working:

- The gaseous methyl chloride (CH_3Cl) is pumped by the compressor C_1 into the spiral tube.The refrigerant in condenser R_1 surrounding this tube starts liquefying the methyl chloride.

- This is because the critical temperature of methyl chloride is 143°C, which is more thanroom temperature as well.

- Now the liquid methyl chloride comes in Condenser R_2 through the tube. Here one portionof condenser R_2 is connected with the suction side of compressor C_1.

- Here due to the evaporation of liquid methyl chloride in reduced pressure, more cooling asa result produced, and the temperature of condenser R_2 decreases more.

- The evaporated methyl chloride return back to the compressor C_1 through the suction sideof the compressor.

- Now the gaseous ethylene (C_2H_4) is pumped by the compressor C_2 into the next spiraltube. 4Mark

- Here the refrigerant, liquid methyl chloride which is achieved in the previous stage, surrounding the tube which contains gaseous ethylene, starts to convert this gas into liquidethylene.

- This is because the critical temperature of ethylene is around 9.2°C.
- Now, this liquid ethylene comes in Condensor R_3, and one portion of R_3 condenser isconnected with the suction side of compressor C_2.

- Here evaporation of liquid ethylene takes place in reduced pressure like in the previous stage, and the evaporated ethylene return back to the compressor C_2 through the suction sideof the compressor.

- Therefore, due to the evaporation process more cooling is produced into the condenser R_3,which is more than the cooling that we achieved in Condenser R_2.

- This cooling has a temperature of around −160°C.

	• Now, the oxygen (which is in gaseous form) is pumped by the compressor C_3 into the nextspiral tube. • Here, due to the very low temperature inside the Condenser R_3 the oxygen gas into thespiral tube starts converting into liquid and later collected into a Dewar flask. • This is because the critical temperature of oxygen gas is around −118°C. • Here, likewise the previous stages, the evaporated oxygen return back to the compressorC_3 through the suction side of the compressor. • If we continue this cascade system, we can liquefy air and other gases like Nitrogen, etc. **Limitation:** By this system, we cannot liquefy the gases that have very low critical temperatures, such as Hydrogen (T_c around −240 °C) and Helium (T_c around −267.8 °C).	
2b	Given: T1=100+273=373 K T2=150+273=423 K , P1=20Pa, P2=170 pa change in temperature from T2- T1 (K) = 50 K change in pressure from P1 to P2 (Pa) = 150MPa JTC = dT / dP = 50K/150MPa =1/3 μK/Pa=0.3333x 10^{-6} K/Pa	1 Mark 1 Mark 2 Mark

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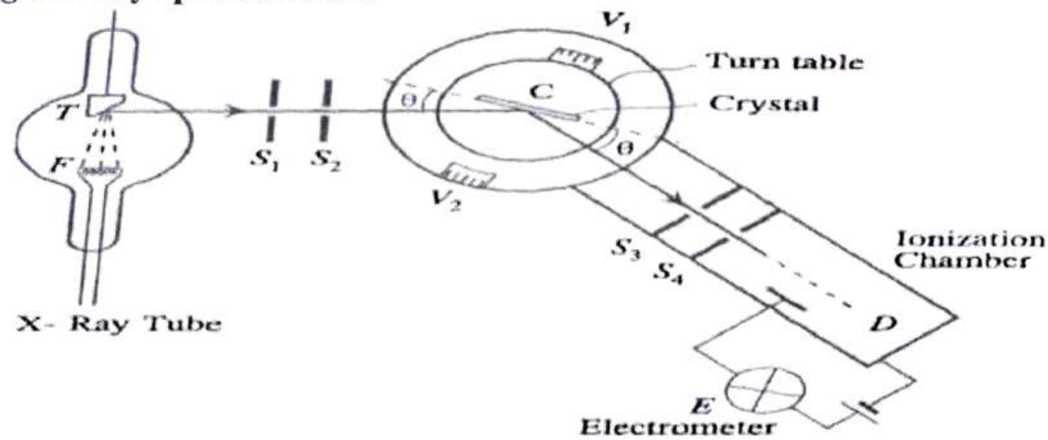
3a

Construction and working:

Bragg's X-ray spectrometer:



1 Mark

Bragg's X-ray spectrometer consists of three parts:

1. A source of X-rays (X-ray tube)
2. A crystal held on a circular turn table provided with vernier
3. A detector (ionization chamber)

3 Mark

- X-rays produced from x-ray tube are made narrow using two lead slits S_1 and S_2.
- This fine beam made to fall on the crystal C fixed on the top of a thin wire mounted exactly at the center of a circular turn table.
- The position of the table can be read by means of a vernier scale, V_1.
- The x-ray beam after reflection, enters an ionization chamber D, which is filled with gas.
- The ionization chamber is mounted on a mechanical arm which can turn coaxially with the turn table.
- But the mechanical arm is so coupled to the turn table that, for every rotation by an angle θ of the turn table, the mechanical arm turns through 2θ.
- Hence the x-rays after reflection from the crystal are always made to enter the ionization chamber D & they are again made into narrow beam by means of slits S_3& S_4 . 3 Mark
- The position of arm carrying the chamber can be read by means of the vernier V_2.
- The x-rays produce ionisation of the gas in the chamber D.
- The ionisation current is measured by the electrometer E.

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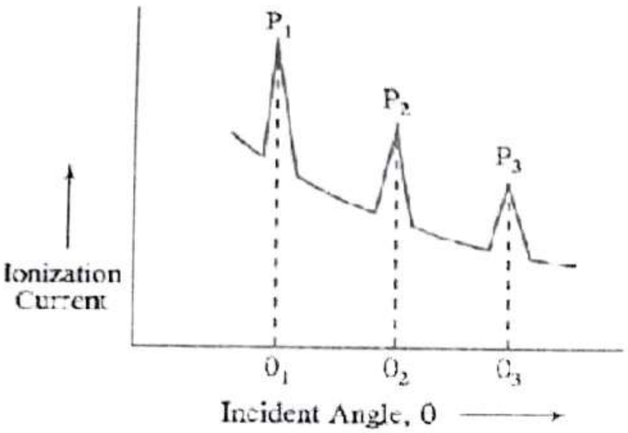
	• The reflected rays from the crystal reinforce, when Bragg's law is obeyed & the intensity of x-rays entering the ionisation chamber increases causing a rise in the ionisation current. • The ionisation current is measured for different values of glancing angle θ. • A graph is drawn between the glancing angle θ & the ionisation current.  • The peaks P_1, P_2, P_3 etc are observed at θ_1, θ_2, θ_3 etc. We know from the Bragg's equation that $2d\sin\theta = n\lambda$ For n=1, $2d\sin\theta_1 = \lambda$ n=2, $2d\sin\theta_2 = 2\lambda$ n=3, $2d\sin\theta_3 = 3\lambda$ ∴ we can write $2dsin\theta_1 : 2dsin\theta_2 : 2dsin\theta_3 = \lambda : 2\lambda : 3\lambda$ Or $sin\theta_1 : sin\theta_2 : sin\theta_3 = 1 : 2 : 3$	1 Mark
3b	$2dsin\theta = n\lambda$ $2dsin4^0 51' = 0.675x10^{-10}$ $d = 3.991\ x10^{-10}$ $\sin\theta = \frac{n\lambda}{2d}$ $\theta = sin^{-1}(\frac{3x0.675x10^{-10}}{2x3.991x10^{-10}}) = sin^{-1}(0.2536) = 14.69^0$	1 Mark 1 Mark 1 Mark 1 Mark

4a

PRINCIPLE:

Due to the bombardment of X-Ray Photon on the sample surface the inner shell electrons(i.e K and L)electron are ejected which are further analysed by the analyser. The monochromatic x-ray Photon when incident on the sample surface the inner shell electron abstract the energy from this x-ray Photon and get ejected in terms of electron. Kinetic energy of the ejected electron is recorded by spectrometer and is given by $E_k = h\gamma - E_B - \varphi$

Where, E_k- is kinetic energy of the ejected electron

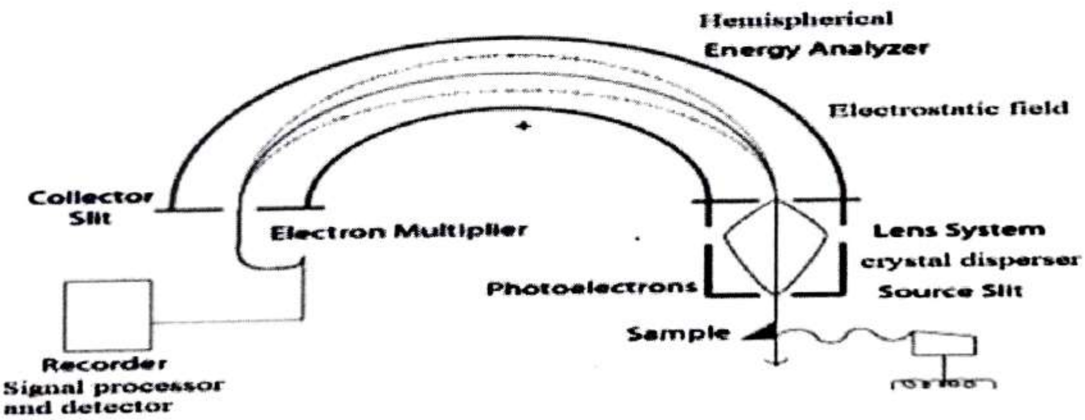
h - energy associated with incident Photon

E_B- binding energy ejected electron

φ -Work function of the instrument.

The energy of an X-ray with particular wavelength is known, and kinetic energies of the emitted electrons are measured by the instrument, φ is the work function for the specific material is known and hence the binding energy of each of the emitted electrons can be determined by using the above equation.

CONSTRUCTION:



1 Mark

The electron spectrometer made up of following components.

- **Source** –To obtain X-ray photon
- **Sample Holder**- To hold the sample and to select the photon of required energy
- **Analyser** – Helps to control the kinetic energy of the photoelectrons and

3 Mark

hence to good resolution

- **Detector-** Detects the electrons emerging out of the analyser and multiply the number of electrons
- **Signal processor and Read-Out system-** To amplify the signal and to produce spectrum

WORKING:

SOURCE:

The simple x-ray Photon source for x-ray photoelectron spectroscopy is X ray tube equipped with magnesium or aluminium metal target. 4 Mark

SAMPLE HOLDER:

Sample holder is located in between the source and the entrance slit of analyser.

Crystal disperser selects the photon of known energy from the source and which is made to incident on the sample.

The area inside the sample holder should be evacuated within 10^{-5} Torr pressure to avoid contamination of the sample surface.

The gaseous samples are introduced into a sample compartment through a slit, to provide required pressure. If the pressure is higher then attenuation of electron beam may take place. If the pressure is lower, weaker signal may be obtained.

ANALYSER:

It is hemispherical in shape with very high electrostatic field is applied on analyser.

Pressure maintained inside the analyser is 10^{-5} torr.

When the electron enters, into the hemispherical analyser, it travels in curved path and radius of curvature depends upon magnitude of field and kinetic energy of the electron.

DETECTOR:

The electron channel multiplayer tube or transducer are required for X-Ray

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	photoelectron Spectroscopy. When single electron pass through the electron multiplier tube it gets converted into number of electrons or pulses of electrons **SIGNAL PROCESSOR AND READ OUT:** The function of signal processor is to amplify the signals and read out device converts signal into spectrum. The spectrum of X-Ray photoelectron spectroscopy is plotted with the number of electrons as a function of energy i.e., kinetic energy or binding energy.	
b	$2dsin\theta = n\lambda$ $\lambda = 2x2.8x10^{-10}sin60$ $\lambda = 4.849x10^{-10}$m	1 Mark 2 Mark 1 Mark

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Department: Physics	Quiz	Academic Year: 2022-23
Class: G	Course: Applied Physics for ME	Course Code: BPHYM202
Date: 22/08/2023	Duration: 1 Hour	Max. Marks: 20

Note:

- **Each question carries ONE mark**
- **Total questions:25**
- **Answer any 20 questions**

1. Condition for under-damped oscillation

a) $b^2 > \omega^2$

b) $b^2 < \omega^2$

c) $b^2 = \omega^2$

d) $b^2 = -\omega^2$

2. A simple pendulum completes 40 oscillations in 64 sec. What is the time period of the pendulum?

a) 1.6s

b) 16s

c)0.6s

d)0.16s

3. Expression for amplitude of forced oscillation at resonance

a) a=$\frac{\frac{F}{m}}{2b\omega}$

b) a=$\frac{\frac{F}{m}}{2b}$

c) a=$\frac{F}{2b\omega}$

d) a=$\frac{\frac{F}{m}}{2\omega}$

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4. Frequency of oscillation(f) is related to period of oscillation(T) through the relation

a) T= f^2

b) T=$\sqrt{f}$

c) T=$\frac{1}{f^2}$

d) T=$\frac{1}{f}$

5. Hooke's law incase of stretched spring states that (F-Force, K-spring constant, x-Displacement)

a) F = $\frac{-K}{X}$

b) F = -Kx

c) K= -Fx

d) x= -FK

6. Angular frequency ω can be given by (if K-spring constant and m- mass)

a) ω=$\sqrt{\frac{m}{K}}$

b) ω=$\sqrt{Km}$

c) ω=$\sqrt{\frac{K}{m}}$

d) ω=$\sqrt{\frac{K^2}{m}}$

7. Two springs with the spring constant 5N/m and 7N/m are connected in parallel. Then the effective spring constant will be

a) 12 N/m

b) 35 N/m

c) 2.916 N/m

d) 1.4 N/m

8. Incase of forced oscillation at resonance angular frequency of oscillating body is equal to angular frequency of applied force

a) True

b) False

9. Incase of forced oscillation at resonance

a) amplitude of oscillation will be zero

b) amplitude of oscillation will be minimum

c) amplitude of oscillation will be maximum

d)There is no oscillation

10. Example for forced oscillation

a) Oscillation of freely oscillating simple pendulum

b) Free oscillations of a swing

c) Oscillation of pendulum of clock

d) Oscillations of shock absorber

11. Stress means

a) $\frac{\text{Restoring force}}{\textit{unit area}}$

b) $\frac{\text{Restoring force}}{\textit{unit volume}}$

c) $\frac{\text{Restoring force}}{\textit{unit length}}$

d) $\frac{\text{Restoring force}}{\textit{unit diameter}}$

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12. Strain is a dimensionless quantity

a) True

b) False

13. Poisson's Ratio (σ) can be given as

a) $\sigma = \frac{\alpha}{\beta}$

b) $\sigma = \frac{\beta}{\alpha}$

c) $\sigma = \alpha\beta$

d) $\sigma = \frac{\beta^2}{\alpha}$

14. Elongation strain + Compression strain = ...

a) Young's modulus

b) Bulk Modulus

c) Rigidity modulus

d) Shear strain

15. Limiting value of Poisson's ratio

a) $10 < \sigma < 50$

b) $2 < \sigma < 5$

c) $0 < \sigma < 0.5$

d) None of the above

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16. At equilibrium bending moment = restoring moment of a beam

a) True

b) False

17. Identify the correct relation

a) Rigidity modulus $\eta = \frac{1}{2(1+\sigma)}$

b) Rigidity modulus $\eta = \frac{Y}{2(1+\sigma)}$

c) Rigidity modulus $\eta = \frac{\alpha}{2(1+\sigma)}$

d) Rigidity modulus $\eta = \frac{\alpha}{2(1+\beta)}$

18. Incase of free oscillations(assuming ideal case)amplitude will be

a) Increasing

b) Decreasing

c) Remains constant

d) Becomes zero

19. Incase of Damped oscillation $\frac{r}{m}$=........

a) 4b

b) $\frac{b}{2}$

c) 2b

d) b^2

20. Incase of damped oscillation resistive force is directly proportional to ....in opposite direction

a)Acceleration

b) Momentum

c) Displacement

d) Velocity

21. If $b^2 > \omega^2$ which kind of damped oscillation will occur

a)Over damping

b) Under damping

c) Critical damping

d) No damping

22. Strain produced in a direction perpendicular to direction of applied force

a) Linear strain

b) Longitudinal strain

c) Tensile strain

d) Lateral strain

23. Which type of stress produces change in volume of the material

a) Compressive stress

b) Linear stress

c) Tangential stress

d) None of the above

24. Strain hardening increases.................of the material

a) Elastic limit

b) Residual strain

c) Yield point

d) Both option a) and c)

25. Moment of applied force is known as

a) Restoring moment

b) Momentum

c) Bending moment

d) Moment of gyration

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BLUE BOOK

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(A Unit of Shri Sode Vadiraja Mutt Education Trust ®, Udupi)
Affiliated to Visvesvaraya Technological University, Belagavi
Vishwothama Nagar, Bantakal - 574 115, Udupi District, Karnataka, INDIA

SMVITM

Name Sagan. S. shetty

USN 4MW22ME011 Semester II

Branch Mechanical Section G

Course Physics Course Code BPHYM202

Faculty Name Usha Parvathi Academic Year 2022 - 23

	Date	Max. Marks	Marks Awarded	Faculty Signature	Remarks
Test 1	10/7/23	25	15	[signature]	Try to improve
Test 2	7/8/23	25	11	[signature]	work hard
Test 3	31/8/23	25	6	[signature]	Work hard
Average (Best two)		15	7.8	[signature]	Need to practice
Assignment/Seminar + Quiz 2		10	9.17		Good
Final Internal Assessment Marks LAB marks		25	23		Try to improve and get good ma

Final IA Marks 50 40

Average Marks 40/50 in words Fourty only

Student Signature Faculty Signature HOD Signature

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DISTRIBUTION OF MARKS

First I.A. Test		Second I.A. Test		Third I.A. Test	
Q. No.	Marks	Q. No.	Marks	Q. No.	Marks
1. a	4	1. a		1. a	
1. b		1. b	1	1. b	4
1. c		1. c		1. c	
2. a	8	2. a		2. a	
2. b	1	2. b	3	2. b	4
2. c		2. c		2. c	
3. a		3. a	8	3. a	
3. b		3. b	0	3. b	2
3. c		3. c		3. c	
4. a	6	4. a		4. a	
4. b	0	4. b	01	4. b	1
4. c		4. c		4. c	
Total Marks	15	Total Marks	11	Total Marks	8
Faculty Signature	[signature]	Faculty Signature	[signature]	Faculty Signature	[signature]

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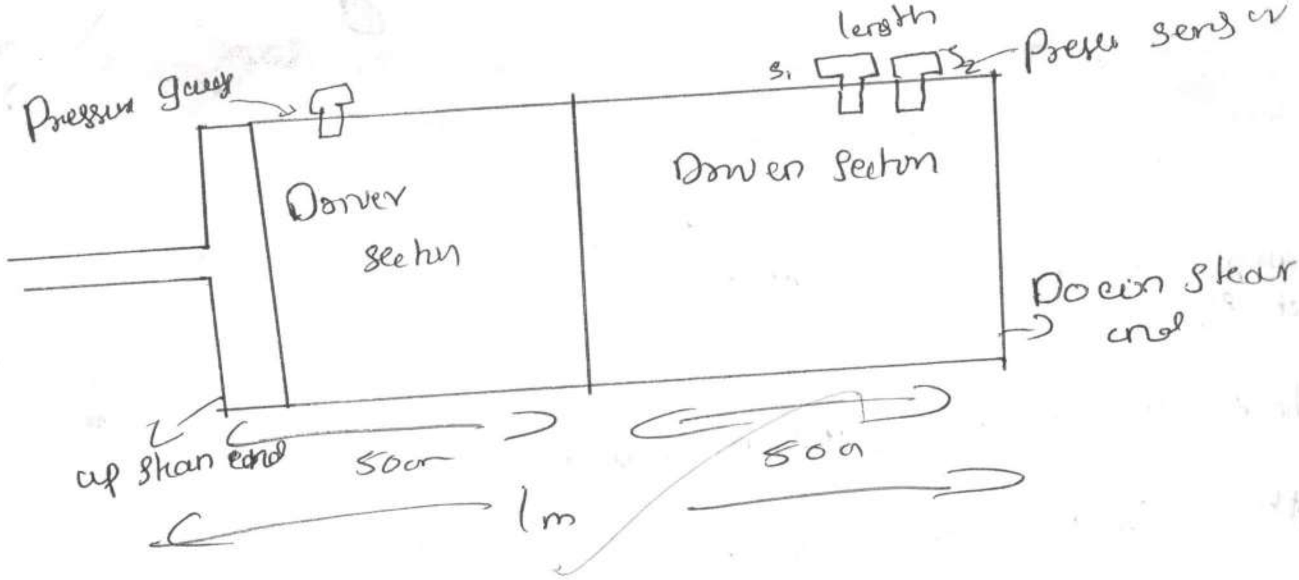
1- IA test.

1]



Construction :-

1] Cylindrical tube of length 1m
2] entire tube is divide into 2 part each of The length of 50cm.
3] Two Sections are seperated by a diaphargm of Thickn 0.1mm.
4] Diameter of the tube is 30mm
5] Two Sections named by driver Sections & driven Sect
6] driver Secton are filled with piston & ~~driven~~ four end Driven Section are open and closed with surronding mediu
7] for The end of the Driver section → up stream end
for the end of the Driven section → down stream end
8) pressure gauge is connected to driver section
9) pressure sensor is connected to driven Section

10) Donor Section & donor Section are must be filled with gas :-

11) gas in the donor Section are called Drain gas.

12) gas in the donor Section are called donor gas.

13) Seperated by The form apart.

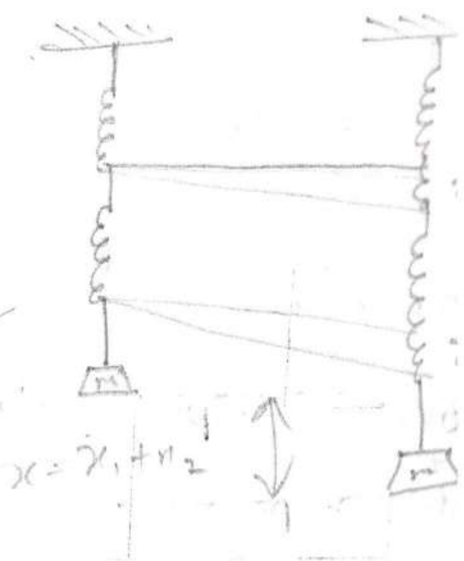
You need to write working also

2a) Spring Constant in series combination.

Let the Spring Constant of Spring S_1, S_2 be The k_1, k_2 respectively. and increase in length S_1 be x_1 and S_2 be x_2.

Let x be the total increase in lengthe of The combination.

'm' mass of The Series combination.



W.k.T

$$x = x_1 + x_2 \quad -(1)$$

By applying hooke's law,

$$F_1 = -k_1 x_1$$

$$mg = -k_1 x_1 \quad -(2)$$

$$F = -k_2 x_2$$

$$mg = -k_2 x_2 \quad -(3)$$

For the combination. $F = -k_s x$

$$mg = -k_s x \quad -(4)$$

$k_s \Rightarrow$ effective spring Constant of Series combination w.k.T

$$x = x_1 + x_2 \quad - (5)$$

Substituting value of x_1, x_2, x to the eq (2), (B), (3) in eq (

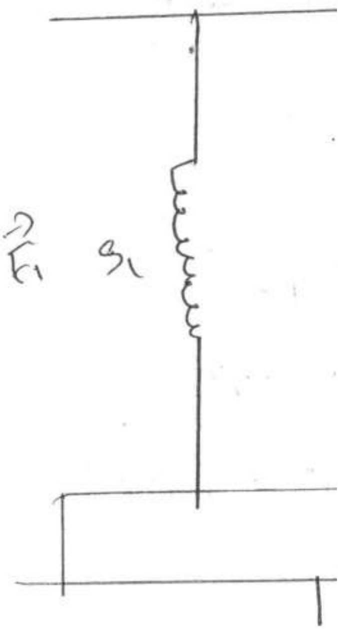
$$-\frac{mg}{K_s} = -\frac{mg}{K_1} + -\frac{mg}{K_2}$$

$$\frac{1}{K_s} = \frac{1}{K_1} + \frac{1}{K_2} \quad \text{and} \quad K_s = \frac{K_1 K_2}{K_1 + K_2}$$

The period of oscillation in series combination is given by

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{K_s}}$$

Spring constant in parallel combination:



Let spring constant of spring S_1, S_2 be K_1, K_2 respectively

Let K_p be the equivalent spring constant of parallel combination.

Let F_1, F_2 be the restoring force acting on S_1 & S_2 respectively.

Let F be the restoring force acting on the combination.

w.k.T

~~$x = x_1 + x_2$~~

$$F = F_1 + F_2$$

By apply hooke's law,

$$F_1 = -K_1 x$$

$$F_2 = -K_2 x$$

$$F = -K_p x$$

The total resting force $F = F_1 + F_2$

$$-K_p x = -K_1 x + (-K_2 x)$$

$$K_p = K_1 + K_2$$

8

• This is equation for equivalent spring constant of parallel

The period of oscillation in parallel combination is given by

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{K_p}}$$

2b.) $K = \frac{Y}{3(1-2\sigma)}$

Substitution wrong

$$= \frac{18\times10^{10}}{3(1-2\times8\times10^{10})}$$

1

$$= \frac{18\times10^{10}}{-4.8\times10^{11}}$$

$$= -0.375$$

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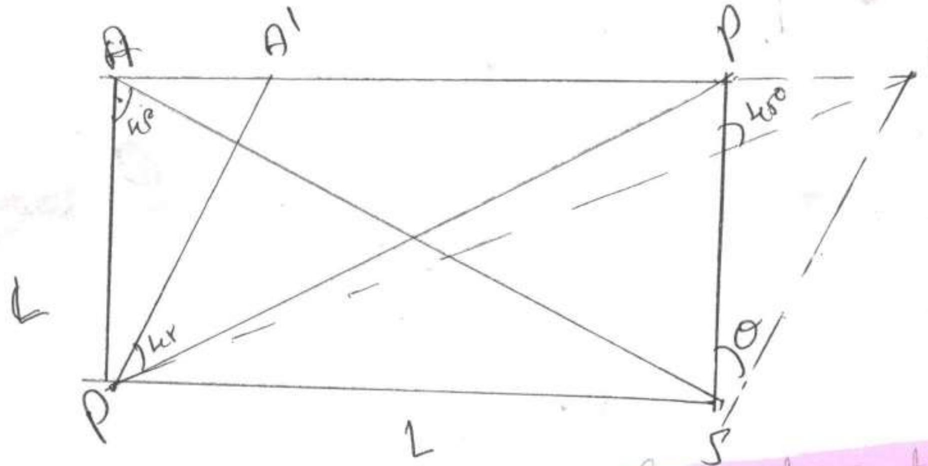
4a]



Explanation is required about the elongation

The Strain along diagonal DP = α.T

The strain along compressive stress DP = β . T

The total strain along DP = $\alpha T + \beta T$

$= (\alpha + \beta) T$

The strain along DP = $\frac{XP'}{DP}$

$\Delta PP'X \cos 45° = \frac{XP'}{PP'}$

$XP' = PP' \cos 45°$

$= \frac{x \times 1/\sqrt{2}}{\sqrt{2} L}$

(diagonal length of DP, $\sqrt{2} L$) $= \frac{x}{2L}$

$= \frac{\theta}{2}$ (shear strain $\theta = \frac{x}{L}$

W.K.T
con ...

$$T(\alpha+\beta) = \frac{\theta}{2}$$

$$\frac{T}{\theta} = \frac{1}{(\alpha+\beta)2}$$

$$\eta = \frac{1}{2\alpha(1+\beta/2)}$$

$$= \frac{1/\alpha}{2(1+\beta/2)}$$

6

$$\eta = \frac{y}{2(1+\sigma)}$$ (since $y = 1/\alpha$)

4b) $$\nu = \frac{1}{2\pi}\sqrt{\frac{m}{K}}$$

Formula wrong

$$= \frac{1}{2\times3.14}\sqrt{\frac{5}{200}}$$

$$= \frac{1}{6.28}\sqrt{\frac{5}{200}}$$

0

$$= 0.159\sqrt{0.025}$$

$$= 0.159 \times 0.158$$

$$= 0.0251 \text{ Hz}$$

15/25

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3(a)

consider a uniform bending whose one ed to rigid sup
if The load is attached to beam, The beam is u
bending experince strain.

A layer AB is in above neutral ~~axis~~ surface will be c
to A'B', The layer EF is below The neutral ~~axis~~ surface
elongated E'F' and Then CD is The neutral ~~axis~~ surface
not change its length.

Let R be The radius of curvature of beam, θ is angle, ~~sub~~

Let $AB = CD = EF = R\theta$ Then change in length of Be

$AB = A'B' - AB$

$= (R+r)\theta - R\theta$

$= R\theta + r\theta - R\theta$

$= r\theta$

linear strain of the layer AB = change in length / original length

$$= \frac{r\theta}{R\theta} = \frac{r}{R}$$

young's modulus of the beam = linear stress / linear strain

$$Y = \frac{F/A}{r/R}$$

F = Applied force

A = Area of cross section

$$F = Y \times \frac{r}{R} \times A$$

At a equilibrium restoring moment = bending moment

Bending moment about the neutral surface $= F \times r$

$$= \left(Y \times \frac{r}{R} \times A\right) \times r$$

$$= \frac{Y}{R} \times A r^2$$

~~$= \frac{Y}{R} \times I_g$~~

~~where $\frac{I_g}{g}$~~

Bending Moment on the entire beam $= \frac{y}{R} \sum A r^2$

$$= \frac{y}{R} \times I_g$$

where $I_g = \sum A r^2$ is the geometric moment of inertia.

$I_g = \frac{bd^3}{12}$ is the rectangular moment of the beam
b - breadth d - Thickness.

- $I_g = \frac{\pi r^4}{4}$ is the circular moment of the beam of ~~radi~~ cross - section of radius r.

8

Bending moment of rectangular beam } ~~$I_g = \frac{bd^3}{12}$~~ $\frac{y}{R} \times \frac{bd^3}{12}$

Bending moment of Circular beam } $\frac{y}{R} \times \frac{\pi r^4}{4}$

3b) $\lambda = 10nm = 10 \times 10^{-9}$

$\beta = 0.5 = 8.72 \times 10^{-3}$

formula wrong

$\theta = 12.5^\circ$

$K = 0.94$ $D = ?$

$D = \frac{\lambda \beta \cos\theta}{K} = \frac{10 \times 10^{-9} \times 8.72 \times 10^{-3} \times co}{0.94}$

$= 9.2561 \times 10^{-11}$

$= 92.56 nm$

0

1b) $e = at + \frac{1}{2} bt^2$

$e = 1200 \mu V$

$T_n = 300^\circ$

$T_n = \frac{-a}{b}$

$300 = \frac{-a}{b}$

$a = -300b$

0) $e = at + \frac{1}{2} bt^2$

Substitution wrong

$1200 = -300bt + \frac{1}{2} bt^2$

$1200 + 300bt = \frac{1}{2} bt^2$

$1500bt = \frac{1}{2} bt^2$

2b) $E = 1784t - 2.4T^2$

$T_n = -\frac{a}{b} = -\frac{1784}{2.4} = -743.333$ b value wrong

$\Pi = TP$

$= T\frac{de}{dt}($

3

~~$= T\frac{d}{dt}(1784T - 2.T^2)$~~ $= T\frac{d}{dt}(1784T - 2.4t^2$

$= T(1784 - 4.8T)$

$\Pi = [1784T - 4.8T^2]$

4b) Bending moment
Circular beam

$\frac{Y}{R} \times \frac{\pi r^4}{4}$

$= \frac{2\times10^{11}}{\text{[illegible]}\times10^{-3}} \times \frac{3.14\times(50)^4}{4}$

$= 9.81\times10^{20}$

01

Substitution wrong

11/25

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III - 1A

1b] $a = 0.244$ atm L2/mol2
$b = 0.027$ L/mol

$R = 0.0821$ L atm/K/mol.

$$T_i = \frac{2a}{Rb} = \frac{2 \times 0.244}{0.0821 \times 0.027}$$

$$= 220.1470\ K$$

4

2b) $$\mu_{jT} = \frac{\delta T}{\delta P} = \frac{T_2 - T_1}{P_2 - P_1}$$

$$= \frac{150-100}{170-20} = \frac{473-373}{170-20}$$

$$= 0.3333 \times 10^{-6}$$

$$= 3.333 \times 10^{-7}\ K/Pa$$

4

3b) $2d\sin\theta = n\lambda$

$$d = \frac{n\lambda}{2\sin\theta}$$

2

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$d = \frac{n\lambda}{2\sin\theta}$

$= \frac{1 \times 0.675 \times 10^{-10}}{2\sin(4^\circ 51')}$

$= -0.3407\ \text{Å}$

Substitution correct

Answer wrong

$\sin\theta = \frac{n\lambda}{2d}$

$= \frac{1 \times 0.675}{2 \times (-0.3407)}$

$\theta = -1.43387^\circ$

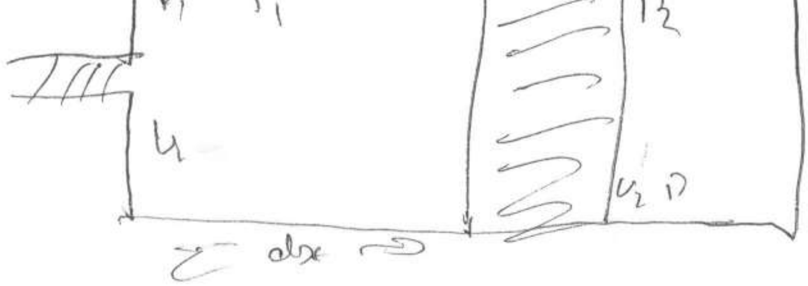
4b) $\lambda = \frac{2d\sin\theta}{n}$ $\{2d\sin\theta = n\lambda\}$

$= \frac{2 \times 2.8 \times \sin(60)}{1}$

Substitution wrong

$= -1.7064$

2a)



Not relevant question

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external workdone by the gas $= (P_2V_2 - P_1V_1)$

internal workdone by the gas $= \int_{V_1}^{V_2} P\,dV$

$$= \int_{V_1}^{V_2} \frac{a}{V^2}\,dV$$

$$= \frac{a}{V_1} - \frac{a}{V_2}$$

W = internal work + external work

Workdone by the gas $(P_2V_2 - P_1V_1) + \left(\frac{a}{V_1} - \frac{a}{V_2}\right)$ —

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

$$PV - Pb + \frac{a}{V} - \frac{ab}{V^2} = RT,$$

$$PV = RT + Pb - \frac{a}{V}$$

$$P_1V_1 = RT_1 + P_1b - \frac{a}{V_1}$$

$$P_2V_2 = RT_2 + P_2b - \frac{a}{V_2}$$

Sub in (1)

$$\left(RT_2 + P_2b - \frac{a}{V_2}\right) - \left(RT_1 + P_1b - \frac{a}{V_1}\right) + \left(\frac{a}{V_2} - \frac{a}{V_1}\right)$$

$$(RT_2 - RT_1) - (P_1b - P_2b) - \frac{a}{V_1} + \frac{a}{V_2} + \frac{a}{V_1} - \frac{a}{V_2}$$

$$= -R(T_2-T_1) - b(P_2-P_1) - \frac{2a}{V_1} + \frac{2a}{V_2}$$

$$= -R\delta T - b\delta P - \frac{2aP_1}{V_1} + \frac{2aP_2}{V_2}$$

$$= R\delta T - b\delta P - \frac{2aP_1}{RT_1} + \frac{2aP_2}{RT_2}$$

Let $T_2 = T_1 = T$.

$$W = -R\delta T - b\delta P - \frac{2aP_1}{RT} + \frac{2aP_2}{RT}$$

$$W = -R\delta T - b\delta P - \frac{2a}{RT}(P_2-P_1)$$

$$W = -R\delta T - b\delta P - \frac{2a}{RT}\delta P$$

$$W = -R\delta T - \delta P\left(\frac{2a}{RT} - b\right)$$

$$C_v\delta T = -R\delta T - \delta P\left[\frac{2a}{RT} - b\right]$$

$$C_v\delta T + R\delta T = \delta P\left[\frac{2a}{RT} - b\right]$$

$$\left\{ C_v = \left(\frac{dQ}{dt}\right)_v \quad C_p = \left(\frac{dQ}{dt}\right)_p \right\} \quad (C_v + R)\delta T = \delta P\left(\frac{2a}{RT} - b\right)$$

6/25

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$$C_p\delta T = \delta P\left(\frac{2a}{RT} - b\right)$$

$$\frac{\delta T}{\delta P} = \frac{1}{C_p}\left[\frac{2a}{RT} - b\right] = \mu_{JT} = \frac{\delta T}{\delta P} = \frac{1}{C_p}\left[\frac{2a}{RT} - b\right]$$

ASSIGNMENT BOOK

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Vishwothama Nagar, BANTAKAL - 574 115, Udupi District, Karnataka, India

सर्वे भद्राणि पश्यन्तु

SMVITM

Name: Srajan. S. shetty

USN: 4MW22ME011 Semester: II

Branch: Mechanical engineering Section: G

Subject: physics Subject Code:

Name of the Faculty: Usha parvathy Academic Year: 2022

Assignment No.	Date	Max. Marks	Marks Awarded	Initials of the Faculty	Remarks
1	17/7/23	20	18	[signature]	Good
2	21/8/23	20	20	[signature]	Very Good
3	22/8/23	20	17	[signature]	Good

Average Assignment Marks: 18.33 / 20

Signature of the Faculty

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Assignment - 1

1. Define Mach number?

→ The Mach number is a dimensionless quantity used dynamics and aerodynamics to describe the speed of an such of an aircraft or a fluid flow, relative to the of sound in the medium through which it is traveling.

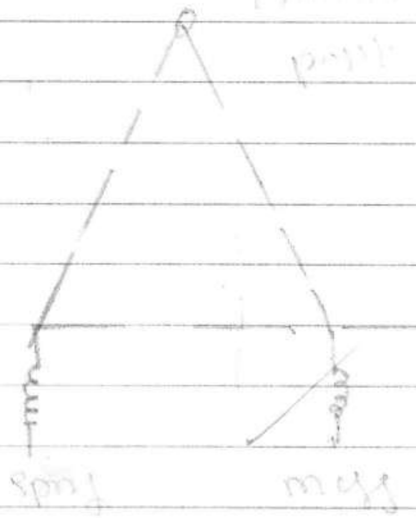
2. Define Thermo emf?

→ Thermo emf stands for Thermo - electromotive force, an refers to the voltage or electrical potential difference generated between two dissimilar conductors when there temperature gradient between them. this phenomenon is ba the Seeback effect, which was discovered by the Eston German physicist Thomas Johann Seeback in 1821.

3. Define Seeback effect?

→ The Seebeck effect is a phenomenon in physics where a voltage electromotive force is generated between two differen when there is a temperature difference across Ther j

4



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$$\frac{d^2x}{dt^2} = -(k/m)x$$

The general solution to this differential equation is a sinusoidal function:

$$x(t) = A\cos(\omega t + \phi)$$

where,

$x(t)$ = displacement of the mass as a function of time.

A = Amplitude of the motion

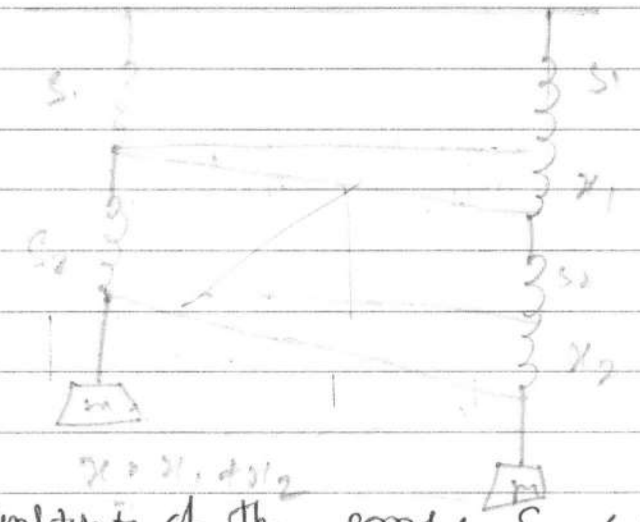
ω = angular frequency

ϕ = phase angle

In simple harmonic motion, the mass oscillates back and forth the equilibrium position with a constant amplitude and a nature described by the cosine function.

5] Obtain the expression for equivalent spring constant of two springs which are connected in series and parallel combination?

→



Let a spring constant of the springs S_1 & S_2 be k_1 & k_2 and increase in length of the springs S_1 be x_1 and that of

Simple harmonic motion:

Let's consider the motion of a mass attached to a spring. In harmonic motion, The restoring force exerted by the spring directly proportional to the displacement of the mass from equilibrium position and acts in the opposite direction to displacement.

Let:

m = mass of the object

k = spring constant

x = displacement of the mass from its equilibrium position,

t = time.

The equation for the force acting on the mass is given by hooke's law:

$$F = -kx$$

where F = force

k = spring constant

x = displacement

According to Newton's law of motion, the force on an object equal to the mass time its acceleration.

$$F = ma$$

Sub the force from ~~Newton's~~ Hooke's law into Newton's second

$$ma = -kx$$

Dividing both sides by "m":

$$a = -(k/m) * x$$

a = acceleration x = displacement t = time

x_2. If x is total increase in length of the spring sy[stem] because of mass 'm'. Then we have,

$$x = x_1 + x_2 \quad -(1)$$

By applying hooke's law on each spring we can write,

$$F_1 = -k_1 x_1 \quad -(2)$$
$$mg = -k_1 x_1$$

$$F_2 = -k_2 x_2 \quad -(3)$$
$$mg = -k_2 x_2$$

For the combination $F = -k_s x$
$$mg = -k_s x \quad -(4)$$

k_s – effective spring constant of series combination.

w.k.t $x = x_1 + x_2$

Sub the value of x_1, x_2 and x from the equation[s] 4 (4) in the eq (5)

Then we can write

$$\frac{-mg}{k_s} = \frac{-mg}{k_1} + \left(\frac{-mg}{k_2}\right)$$

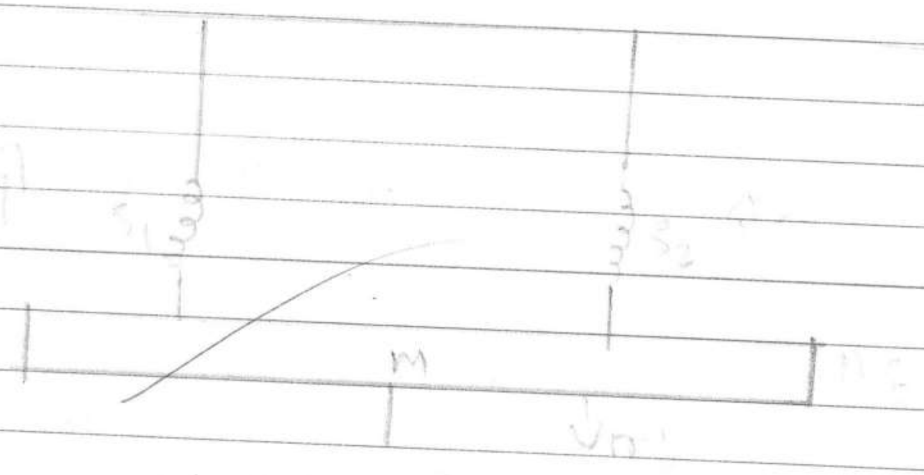
$$\frac{1}{k_s} = \frac{1}{k_1} + \frac{1}{k_2} \quad \text{or} \quad k_s = \frac{k_1 k_2}{k_1 + k_2}$$

for series combination of spring mass system the period [of] oscillation is given by,

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{k_s}}$$

parallel combination

Consider two spring S_1 & S_2 which are connected in pa[rallel as] shown in the figure. each spring we shall the total



Let k_1, k_2 are the spring constant of spring S_1 & S_2 a[nd] and kp be equivalent spring constant of combination. Le[t F_1, F_2] be The Restoring force acting on the spring S_1, S_2 resp[ectively] and F is The restoring force acting on The Combination

By applying hooke's law,

$$F_1 = -k_1 x$$
$$F_2 = -k_2 x$$
$$F = -k_p x$$

The total Restoring, $F = F_1 + F_2$

By sub The value from above eq we can write

$$F = F_1 + F_2$$
$$-k_p x = -k_1 x + (-k_2 x)$$

$\therefore K_p = K_1 + K_2$

This is the equation for equivalent spring constant of the springs are connected in parallel combination.

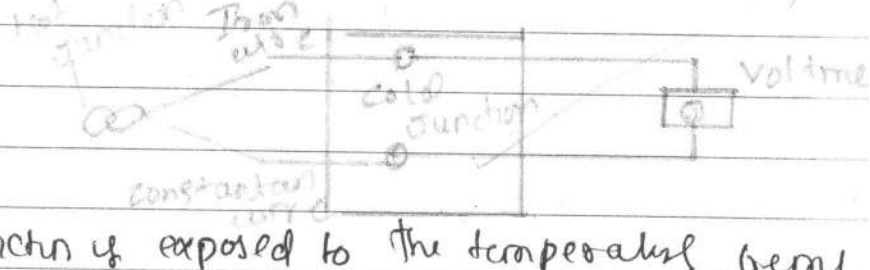
for this combination period of oscillation given by

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{K_p}}$$

6] explain the construction and working of thermocouple?

→ Construction:-

A thermocouple typically consist of two different metal or conductors that are joined together at one end to the measurement junction. The other ends of the are connected to a temperature,, measuring instruments, such as a voltmeter or a temperat controller. this end is called the reference junction or the cold. The two most common metal used in thermocouples usualy designated as positive and negative wires. Com Thermocouple types include type K, Type J, Type T many others, each having its specific temperature r and application.



working principle:-

- The measurement junction is exposed to the temperature being -red.
- The reference junction is maintained at a known temper often achieved using a temperature - controlled environ

or a reference temperature Sensor.

- The temp difference btw the measurement and reference generates a voltage according to the seebeck effec
- the voltage is measured by a voltmeter converted into reading using specialized instruments or electronic cir
- The temperature reading is displayed or used for co purposes, depending on the application.

It's essential to note that the ThermoCouple's voltage relatively small & requires careful measurement and cali to obtain accurate temperature reading. However Thermocou highly versatile & can measure temperature from extreme (-200°C) to very high (Over 2000 °C) temperature ra making Them Suitable for a wide range of industri Scientific applications.

~~Fig~~ ?

7) calculate The period of oscillation of a mass 0.5 kg if it ca extension of 0.03m in a spring. if the system set to oscillations?

$\Rightarrow T = 2\pi\sqrt{\frac{m}{k}}$ $\qquad F = -kx \qquad F = mg$

$= 2\times3.14\sqrt{\frac{(0.5)}{4.908}}$ $\qquad k = -F/x$

$T = 2\times3.14\sqrt{0.102}$ $\qquad = -mg/x$

$T = 2\times3.14\times0.3193$

$T = 2.0043$ $\qquad = \frac{-(0.8 kg \times 9.81)}{0.03} = 163.3$

$= ~~4.908~~ N/m$

So, the period of oscillation of the mass spring System is approximately 2.004 s.

8] The emf in a thermocouple, when one junction of which is at 0 °C, is given by E = 1600t − 4t2 (m µ volts) where t is temp in 0 °C find the neutral Temperature?

⇒ given the emf equation for the termocouples as:

$E = 1600t - 4t^2$

$0 = 1600t - 4t^2$

$0 = t(1600 - 4t)$

$t = 0$

$1000 - 4t = 0$

for the 1st possibility (t = 0), This represent the emf when the temperature is 0 °C

2nd possibility:

$1606 - 4t = 0$

$4t = 1600$

$t = 400$

Thus, the Second solution given is t = 400 °C. This represents the neutral temperature of the thermo couples, where the emf become Zero. At this temperature, the two Junction of the thermocouples are at the Same temperature, & There is no potential difference between them.

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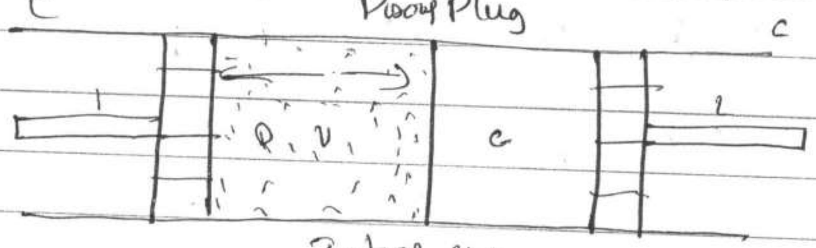
Assignment - II

(1) what are nano-composites?

=> Nano composites are materials that combine two or more components at the nanoscale, Typically with one components having nanoparticles dispersed without a matrix. These nanoparticles are usually nanofillers and they are to the matrix material to enhance its properties.

Define
2) ~~Describe~~ The Joule - Thomson effect?

change in Temperature That accompanies expansion of without ~~prod~~ heat.



Initial state

external work done by the gas $= P_2V_2 - P_1V_1$ - - - (1)

internal work done by the gas $= \int_{V_1}^{V_2} P\,dV$

$$= \int_{V_1}^{V_2} \frac{a}{V^2}\,dV$$

$$= \left[-\frac{a}{V}\right]_{V_1}^{V_2}$$

$$= \frac{a}{V_1} - \frac{a}{V_2} \quad \text{- - - (2)}$$

W = external work + internal work

$$W = P_2V_2 - P_1V_1 + \frac{a}{V_1} - \frac{a}{V_2} \quad \text{- - - (3)}$$

Net work done by the gas $\left(P+\frac{a}{V^2}\right)(V-b) = RT$

$PV = RT + Pb - \frac{a}{V}$ (neglecting $\frac{ab}{V^2}$)

$P_1V_1 = RT_1 + bP_1 - \frac{a}{V_1}$

$P_2V_2 = RT_2 + bP_2 - \frac{a}{V_2}$

Sub the values for P_1V_1 and P_2V_2 in eq (3) we get

$$W = R(T_2 - T_1) - b(P_1 - P_2) + \frac{2a}{V_1} - \frac{2a}{V_2}$$

Since a & b are very small $PV = RT$ or $V = RT/P$

$V_1 = RT_1/P_1$ and $V_2 = RT_2/P_2$

As T_1 & T_2 are nearly equal, we may write $T_1 = T_2 =$

and hence $V_1 = \frac{RT}{P_1}$ and $V_2 = \frac{RT}{P_2}$

Sub in eq (4) we have,

$$W = R(T_2 - T_1) - b(P_1 - P_2) = \frac{2a}{RT} [$$

Let $T_1 - T_2 = \partial T$. Then

$$W = -R\partial T - b(P_1 - P_2) + \frac{2a}{RT}(P_1 - P_2)$$

$$W = (P_1 - P_2)\left(\frac{2a}{RT} - b\right) - R\partial T \quad \text{--- (5)}$$

heat lost by the gas $= C_v \partial T$

$$C_v \partial T = (P_1 - P_2)\left(\frac{\partial a}{RT} - b\right) - R\partial T$$

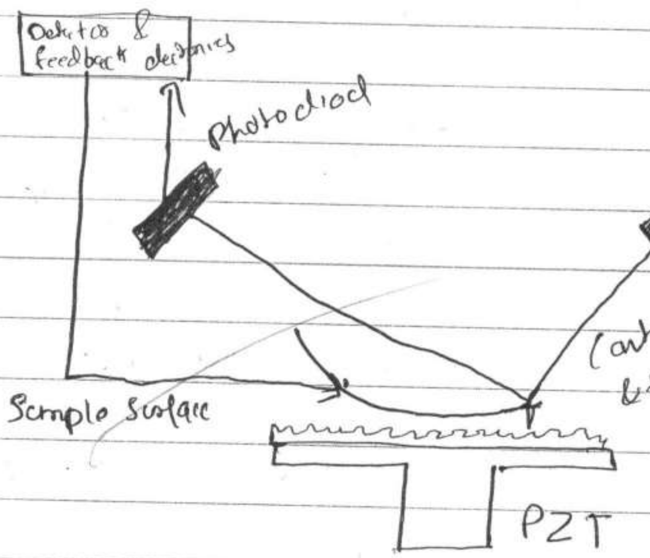
$$\partial T (C_v + R) = (P_1 - P_2)\left(\frac{\partial a}{RT} - b\right)$$

$$\partial T C = (P_1 - P_2)\left(\frac{\partial a}{RT} - b\right)$$

$$\delta T = \frac{(P_1 - P_2)}{C_p}\left(\frac{\partial a}{RT} - b\right) \quad \text{---} \quad (6)$$

$$\mu_{JT} = \frac{\partial T}{\partial P} = \frac{1}{C_p}\left(\frac{\partial a}{RT} - b\right)$$

3. explain the Construction and working of AFM?



Construction:

- Sample holder – To hold the sample.
- Sample – Sample to be investigated is kept on the Sam holder.
- piezoelectric tube (PZT) – helps to move the sample in di direction.

- Laser – To detect the deflection of cantilever.
- cantilever tip – To scan the surface of the sample.
- photodetector – To detect the deflected x-ray beam in backside of the cantilever.
- feedback control loop – which helps to monitor the scanning and its measurements
- Computer system – helps to get the images of the samp with help of software system.

Working :

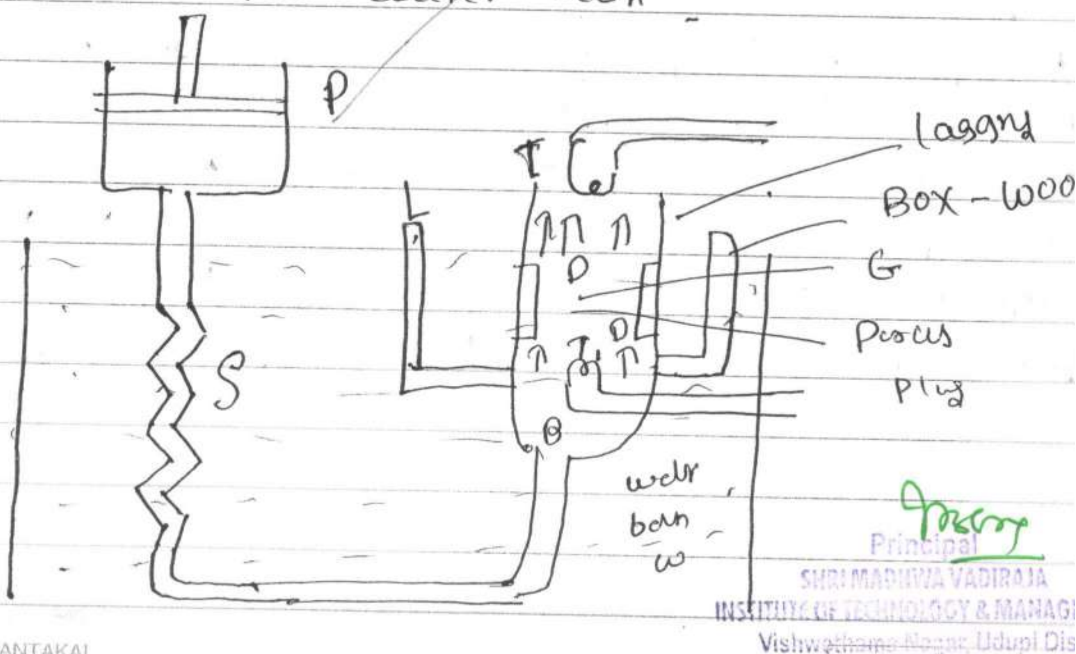
- working surface includes surface sensing, Detection and In
- In a AFM, a tip is used for imaging. It approach sample in a range of intraatomic distances attached t end of the spring cantilever
- The forces between the tip and sample lead to a de of a cantilever according to Hooke's law.
- This deflection is characterizing sensing the reflected light from the backside of cantilever with position se photodiode.
- The cantilever deflects according to the atomic force between tip and the sample and hereby the detector m the deflection.
- As the tip travels across the sample it's moves up according to surface property of the sample
- The microscope has a feedback loop that controls th interaction and the tip positions., while the tip interact the surface of the sample, the position of reflected lo on the photodector is used in the feedback loop for the surface of the sample and measurement and then graphical image is obtained.

4) Explain the Construction and working of Porous plug e

Construction:

Joule in collaboration with Thomson devised a very sensi[tive] technique known as Porous Plug experiment. The experiment s[...] porous plug experiment to study the Joule - Thomson [...]

(a) A porous plug having two perforated brass discs D & [...]
(b) Space btw D & D, is packed with cotton wool fibres.
(c) The porous plug is fitted in a cylindrical box - w[...] which is surrounded by a vessel containing cotton wool [...] to avoid loss or gain of heat from the surroundings.
(d) T_1 & T_2 are two sensitive platinum resistance thermom[eters]. They measure the temperature of the incoming and ou[tgoing gas].
e] The gas is compressed to a high pressure with the piston P and it is passed through a spiral tube immer[sed in a water] bath maintained at a constant temperature. If there is [...] of the gas due to compression, the heat is absorbed [by the] circulating water in the water bath



expermental procedy :-

The gas is compressed by a pump P and slowly and uniformly through the porous plug keeping the high constant read by pressure guage. during the passage through plug. The gas is throttled. the separation b/w the molecules. by passing through the porous plug. the volume of gas against atmospheric pressure as there is no gas lose or gain during the whole process. The expansion of the gas takes place trcally.

experimental results:

A simple arrangement of porous plug experiment. The of large no of gases was studied at various inlet tem of the gas and the results are as follows.

(1) At sufficiently low temperatures, all gases show a effect.

(2) At ordinary temp, all gases except hydrogen & helium cooling effect. hydrogen and helium show heating effect

(3) The fall in Temp is directly proportional to the di in pressure on the two sides of porous plug.

(4) The fall in Temp for a given temp difference with the initial Temp of the gas It was found that the decrease with incres of initial temp and become zero temp and at a temp higher than the temp instead heating was observed. This particular Temp at which Thomson effect changes sign is called temp of invers

5. Determine the crystalline size given the wavelength, the peak width 0.5° and peak position 28° for crystal given K = 0.94?

→ $D = \frac{K\lambda}{\beta \cos\theta}$

$\frac{\pi}{180} \times 0.5 =$ ...

$= \frac{0.94 \times 10 \times 10^{-9}}{0.5 \times 28}$

$= \frac{0.94 \times 10 \times 10^{-9}}{8.77 \times 10^{-3} \times \cos(28)}$

$= 1.1886 \times 10^{-6}$

5

(8) In a Joule Thomson experiment temp changes from 100°C to ... for a change of pressure from 20 MPa to 17 MPa. Calculate ... Thomson effect

$\mu_{JT} = \frac{\partial T}{\partial P} = \frac{T_2 - T_1}{P_2 - P_1}$ $T1 = 100 + 273 = 373$ $P1 =$ ...

$T2 = 180 + 273 = 453$ $P2$ ...

$= \frac{180 - 100}{170 - 20}$ change in temp $T_2 - T_1 (K) = 8$...

$= \frac{50}{150}$ change in pressure from P1 to P2 (Pa) = ...

$\mu_{JT} = \frac{\partial T}{\partial P} = \frac{80}{150} = 1/3 \ \mu K/Pa$

$= 0.333 \ \mu K/Pa$

5

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Quiz

1. b] $b^2 < \omega^2$

2. d] 0.63

3. c] $\frac{F}{2b\omega}$

4] d] $T = \frac{1}{f}$

5] b] $F = -kx$

6] c] $\omega = \sqrt{\frac{k}{m}}$

7] a] 12 N/m

8] a] True

9] a] amplitude of oscillation will be zero

10] a] oscillations of shock absorber

11] a] $\frac{\text{Restoring force}}{\text{unit area}}$

12] a] True

13] 1] $\sigma = \frac{\beta}{\alpha}$

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14) a) shear strain

15) c) 0 < σ < 0.5

16) a) True

17) b) Rigidity modulus $\eta = \frac{Y}{2(1+\sigma)}$

18) a) becomes 2e00

19) c) 2b

20) a) velocity

21) b) under damping

22) c) Tensile strain

23) a) Compressive stress

24) d) Both a) & b)

25) c) Bending moment