ACADEMIC YEAR 2022 - 2023

Program	Year	Semester	Paper
PE	3	1	MAIN

MODULE NAME:	**ENGINEERING MATERIALS**		
MODULE CODE:	**TEM**	**EXAM DATE:**	**27. 12. 2022**
TEACHER'S NAME:	**Dr. J. Sadhik Basha**	**DURATION:**	**2 hrs.**

Questions to be answered on:	**Allowed requirements:**	**Number of pages**
✓ Space provided on the question paper	Pen, Pencil & Calculator	(Incl. cover page): 9

Points of attention:

- For each question, the maximum earned points are mentioned between brackets at the end of each question.
- Write very clearly! Answers that are not readable are not marked and don't get points!
- Make sure your answers are written to the point.
- All answers should be written **in English.**
- Write all the answers in **blue or black pen only.**
- Use the **pencil** only for **diagrams & graphs.**
- Show all the calculation steps in the given space.
- When finished submit the question paper, together with the answer scripts and the signed cover page to the invigilator.
- Any cheating/copying may result in an instant failing of the examination.

STUDENT NAME:

STUDENT ID:

FINAL MARKS	
	40
	10

Number of answer scripts:……..…….. **Invigilator:**……..……..…..

Student's signature: …… **Time of receipt:**……..…..

General Instructions

- *Use your personal calculator only*
- *Draw the figures wherever if necessary*
- *Express the **CORRECT UNITS** for all the dimensional quantities or ½ **MARK** will be deducted for each answer*

ANSWER ALL THE QUESTIONS

[4 × 10 = 40 marks]

1. The relationship between the spacing of atomic planes in crystals and the angles of incidence produce the powerful reflections of electromagnetic radiations (like gamma rays, and X rays). In this perspective, X-ray diffraction methods are generally utilized to determine the glancing angle and spacing of atomic planes of some crystals.

In a certain investigation, **the spacing of atomic planes in crystals has to be determined**, when the X-ray beam of wavelength (0.675 Angstrom) incident at a glancing angle of 5.25 degrees.

Eventually, **also determine the following:**

a. The glancing angle for the second-order diffraction.

b. The glancing angle for the third-order diffraction.

c. Percentage of degree of variations between the third order glancing angle & second order glancing angle.

[10 Marks]

(Callister & Rethwisch, 2008) **(MLO 1)**

2. In designing structures and machines, it is important to consider the strength of the material so that the material should have adequate strength to resist applied loads or forces and retain its original shape. As such, **a square steel bar** of a certain thickness has to be **designed and constructed** for a specific application.

With the aid of a neat diagram, evaluate and analyze the following:

a. The **change in thickness** of the square-shaped steel bar of side 50 mm on a side and 1 m long, when it is subjected to an axial tensile load of 250 kN (*Take the young's modulus of elasticity (E) of the steel as 200 GPa and Poisson ratio as 0.3)* **(8 marks)**

b. Instead of axial tensile load, if the axial compressive load is applied to the above square-shaped steel bar, what would be the thickness? **(2 marks)**

(Bansal, R.K. 2010) **(MLO 3)**

3. The strength of a material is its ability to withstand this applied load without failure or plastic deformation. As such, stresses and load has to be determined for a composite bar arrangement system. A steel rod of 30 mm diameter is enclosed centrally in a hollow copper tube of external diameter 50 mm and internal diameter of 40 mm. The composite bar is then subjected to an axial pull of 45 kN.

If the length of each bar is equal to 150 mm, **determine** the following design attributes with the **aid of a neat diagram**:

a. The stresses in the steel rod and in the hollow copper tube,

b. The individual load carried by the steel rod and hollow copper tube.

Take, "E" for steel = 2.1 x 10^{11} N/m^2 ; "E" for copper = 1.1 x 10^{11} N/m^2 . **[10 marks]**

(Bansal, R.K. 2010) **(MLO 3) SO b**

4. In a petrochemical industry, some steel structures are used to support some process equipment corroded intensively. Suggest some methods to avoid corrosion on the steel structures in detail with aid of neat diagrams. **[10 marks]**

(MLO 4)

References

- Bansal, R.K. (2010). Strength of Materials, New Delhi, Laxmi Publications.
- Callister, W. D., & Rethwisch, D. G. (2008). Fundamentals of Materials Science and Engineering: An integrated approach. Hoboken, NJ: John Wiley & Sons.