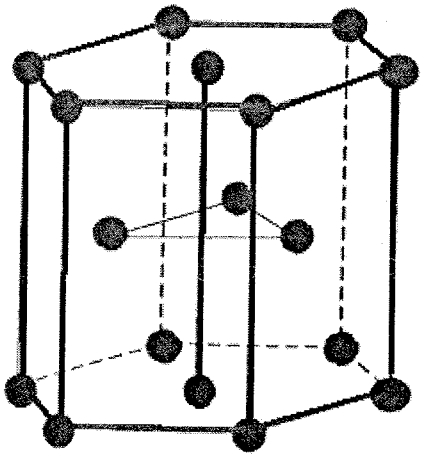
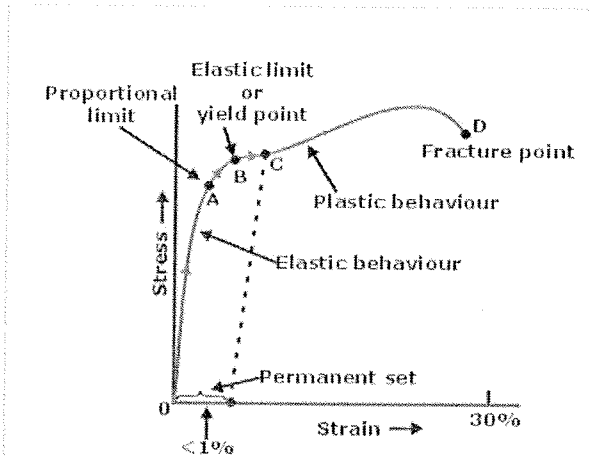
Set II

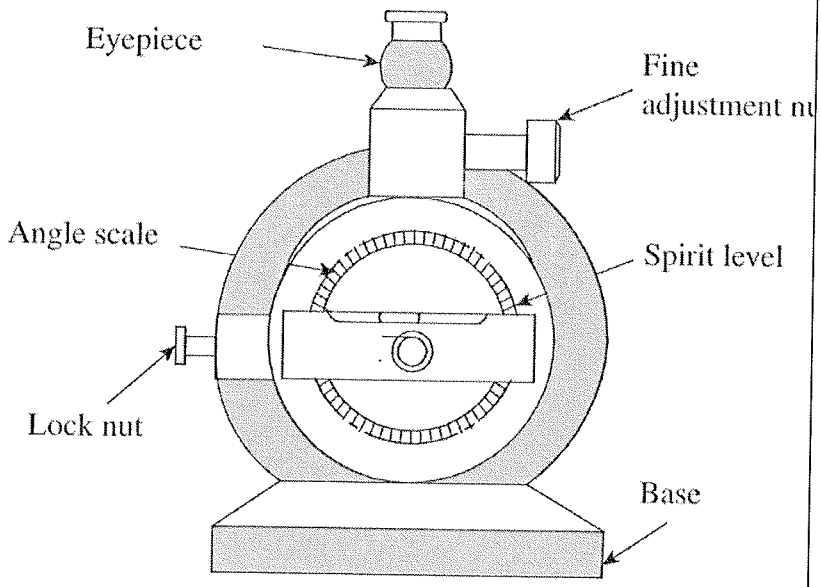
Scoring Indicators

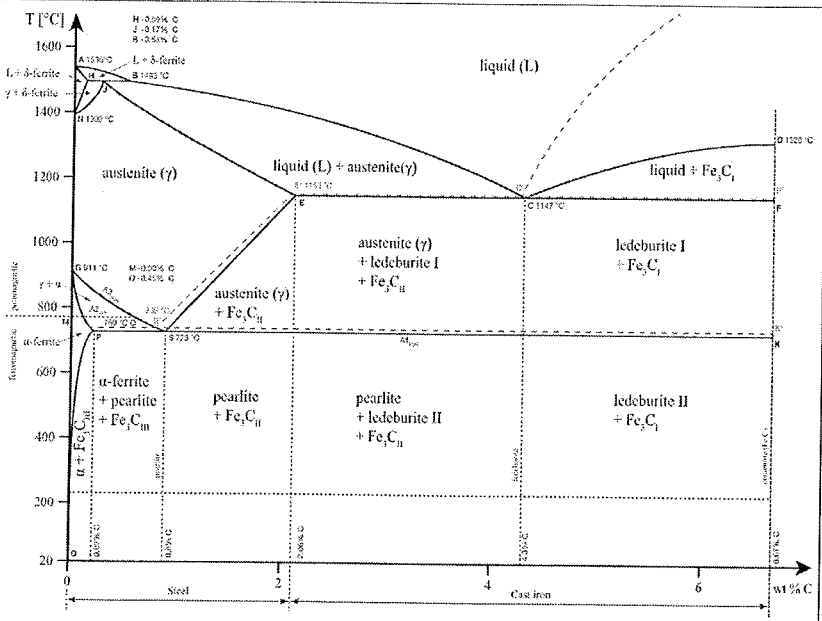
COURSE NAME: REV (21)- 3022- MATERIAL SCIENCE AND METROLOGY

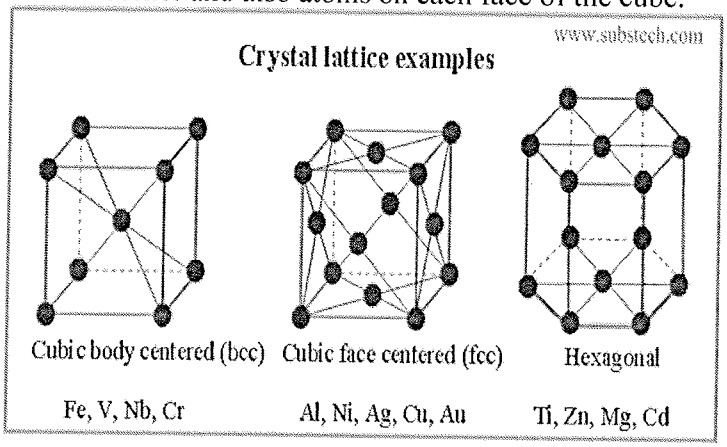
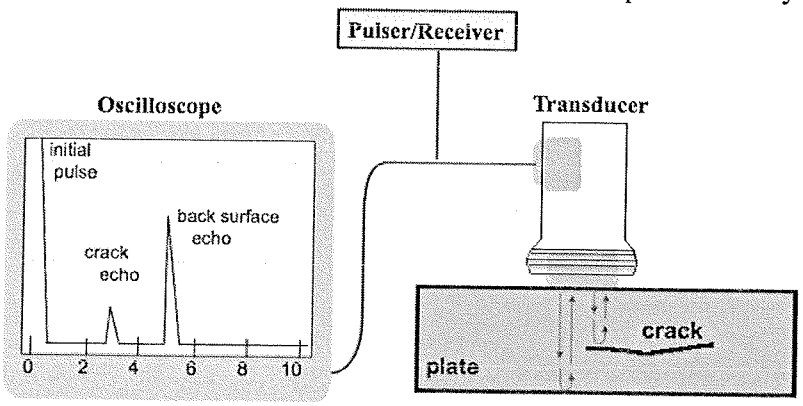
COURSE CODE: 3022

Q. No	Scoring Indicators	Split score	Sub total	Total score
	PART A			**9**
I.1	3-dimensional arrangement of imaginary lines connecting atoms		1	
I.2	Measure of the resistance to localised plastic deformation		1	
I.3	Capillary rise		1	
I.4	Unaided visual inspection- using naked eye Aided visual inspection- using optical instruments		1	
I.5	Failure due to constant load or constant stress at high temperature		1	
I.6	Cup and cone fracture		1	
I.7	Method where value of the quantity to be measured is obtained directly without any calculations.		1	
I.8	Using sine bar, bevel protractor, clinometer [any two]		1	
I.9	Process marks or witness marks produced by the action of cutting tool		1	
	PART B			**24**
1.	Hexagonal close packing (HCP): Hexagonal prism with an atom at each vertex and 3 atoms at centre. 	1 2	3	
2.	Pig Iron: Production: smelting iron ore with high carbon fuel and reductant such as coke usually with limestone. Composition: Fe 90- 95%, C 3- 4.5%, Si 0.5- 4%, P 0.025- 2.5% etc	2 1	3	
3.	Ductile fracture: Appreciable plastic deformation prior to failure		3	

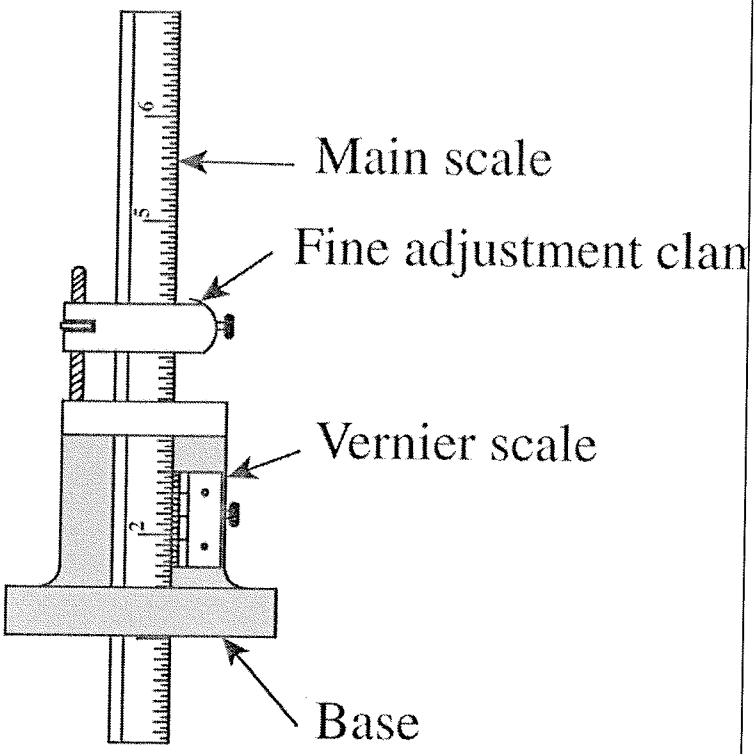
	Fractured surface gives a cup and cone appearance Fracture starts after necking Formation of microcracks, growth of cavities, cavities join together to from crack at centre.			
4.	**Typical Stress-Strain Curve For Ductile Material**  		3	
5.	VHN=$(1.72P)/d^2$ P is standard load, d is length of diagonal between corners of square indentation		3	
6.	Liquid Penetrant Testing: To detect surface defects such as seams, porosity, folds etc Applied to ferrous, non-ferrous, and non-magnetic materials Steps: surface preparation, penetrant application, removal of excess penetrant, developing, inspection, cleaning		3	
7.	• Primary detector- transducer stage • Intermediate modifying stage • Output or terminating stage	1 1 1	3	
8.	A spring balance is an instrument consisting of a hook attached to the end of a spring, used for weighing objects. . It works using the principle of **Hooke's Law**, which states that the force needed to extend a **spring** is proportional to the distance that **spring** is extended from its rest position.. A **spring scale** cannot measure mass, only weight.		3	
9.	Autocollimators may be classified into three types: 1. Visual or conventional autocollimator 2. Digital autocollimator 3. Laser autocollimator	1 1 1	3	

10.	 **Fig. 5.21** Clinometer		3	
	PART C			**42**
1.	Stainless steel: • Iron - 75% • Chromium - 15% • Nickel - 9-9.5% • Manganese - 0.5% **Applications:** Food and catering Chemicals and pharmaceuticals Medical equipment manufacturing Architecture and construction Home appliances Offshore and shipbuilding Automotive manufacturing Energy and industry **Properties**	3 2	7	

	The corrosion resistance of stainless steel is mostly a result of the chromium content. A stable layer of chromium oxide is formed on the surface of the steel, which prevents chemical reactions with the bulk of the material. As the term stainless steel encompasses a wide range of materials, the mechanical properties, of course, are quite diverse. In general, the values tested for include yield strength, tensile strength, ductility, hardness, toughness, creep resistance and fatigue resistance. Specific values can be found on Matmatch for thousands of different stainless steels.	2		
2.	Isomorphous system: This system is the one in which the solid has the same structure for all compositions. Eg: Copper Nickel alloy Eutectoid system: Homogeneous solid mixture that forms from cooling two or more melted metals to a certain temperature. Eg: Pearlite Eutectic system: Homogeneous mixture of substances that melts or solidifies at a single temperature that is lower than the melting point of any of its constituents. Eg: Silver Gold system	2 2 3	7	
3.			7	
4.	• **Simple cubic lattice(SC)**- atoms will be present at each corner. • **Body centered cubic lattice (BCC)**- atoms will be present at each corner and also at the centre of the cube.	3	7	

	• **Face centered cubic lattice (FCC)**- atoms will be present at each corner and also atoms on each face of the cube.  	4		
5.	Pulse echo system: It is used to measure the propagation speed of pulse of ultrasonic longitudinal stress waves. A pulse of ultrasonic longitudinal stress waves is introduced into surface of a concrete by a transducer coupled to the surface with a coupling gel or grease. The pulse travels through the concrete and is received by a similar transducer coupled on the other surface. The transmit time of the pulse is determined by the transit tine to obtain the pulse velocity.  	4 3	7	
6.	**Case hardening:** 3 methods of case hardening: **Carburising**: steel or iron is heated in contact with a carbonaceous material like barium carbonate to its critical temperature. Carbon enters the metal to form a solid solution with Iron and converts the outer surface into high carbon steel , and this process is called Carburising. **Cyaniding:** combined absorption of carbon and nitroghen to obtain surface hardness in low carbon steels that don't respond the ordinary heat treatment. Immersing in a bath having fused sodium cyanides salt at about 350 degree Celsius. **Nitriding**: steel is heated to a temperature of about 654 degree Celsius in the atmosphere of NH_3 gas and held there for a period	1 2 2 2	7	

	of time. Nitrogen is introduced into steel giving extreme hardness to surface.			
7.	**Hysterisis**: phenomenon under which the measuring instrument shows different output effects during loading and unloading. **Calibration**: process of configuring an instrument to provide a result for a sample within an acceptable range. **Threshold**: minimum change in the quantity being measured which produces perceptible movement of the index. **Range**: range of values of the measured quantity for which the error obtained from a single measurement under normal conditions of use does not exceed the maximum permissible error.	2 2 1 2	7	
8.	**Generalised measurement system:** Primary stage senses the quantity to be measured and convert it into analogous signal. The device used for detecting input signal is known as transducer. This signal is passed on to intermediate modifying stage, where signal is amplified and modified and passed on to the final stage. The output will be displayed in the final stage.		7	
9.	Classification of Errors: • **Static errors**- result from the physical nature of various components of the measuring system. (i) Reading errors- directly involved with read-out device (ii) Characteristic errors- defined as the deviation of the output of the measuring system from the theoretical predicted performance. (iii) Environmental errors- these errors result from effect of surroundings • **Instrumental loading errors**- difference between the value of measurand before and after the process of measurement • **Dynamic errors**- caused by time variations in the measurand.	3 2 2	7	
10.	**Mechanical strain gauge:** It is employed for measuring small deformations under linear strain conditions over gauge lengths up to 200 mm. The strain obtained is magnified by employing mechanical means. Lever systems are employed for amplifying the displacements measured over the gauge lengths. Mechanical strain gauges comprise two gauge points: one is a fixed point and the other is connected to the magnifying lever. Both points are placed on the specimen. The displacement caused is magnified by the lever and is indicated in the dial indicator. Strain is determined by dividing the measured displacements over the gauge length. One of the main advantages of a mechanical strain gauge is that it contains a self-contained magnification system. There is no need to use auxiliary equipment in a mechanical strain gauge. It is best		7	

	suited for conducting static tests. The following are some obvious disadvantages associated with a mechanical strain gauge: 1. Its response is slow due to high inertia, and friction is more. 2. Automatic recording of the readings is not possible. 3. It cannot be used for dynamic strain measurements and varying strains.			
11.	A vernier depth gauge is a more versatile instrument, which can measure up to 0.01 mm or even finer accuracy. The lower surface of the base has to butt firmly against the upper surface of the hole or recess whose depth is to be measured. The vernier scale is stationary and screwed onto the slide, whereas the main scale can slide up and down. The nut on the slide has to be loosened to move the main scale. The main scale is lowered into the hole or recess, which is being measured.  	3 4	7	
12.	**MECHANICAL–OPTICAL COMPARATOR** This is also termed as Cooke's Optical Comparator. As the name of the comparator itself suggests, this has a mechanical part and an optical part. Small displacements of a measuring plunger are initially amplified by a lever mechanism pivoted about a point. The mechanical system causes a plane reflector to tilt about its	5	7	

axis. This is followed by a simple optical system wherein a pointed image is projected onto a screen to facilitate direct reading on a scale.

The plunger is spring loaded such that it is biased to exert a downward force on the work part. This bias also enables both positive and negative readings, depending on whether the plunger is moving up or down. The scale is set to zero by inserting a reference gauge below the plunger. Now, the reference gauge is taken out and the work part is introduced below the plunger. This causes a small displacement of the plunger, which is amplified by the mechanical levers. The amplified mechanical movement is further amplified by the optical system due to the tilting of the plane reflector. A condensed beam of light passes through an index, which normally comprises a set of cross-wires. This image is projected by another lens onto the plane mirror. The mirror, in turn, reflects this image onto the inner surface of a ground glass screen, which has a scale. The difference in reading can be directly read on this calibrated screen, which provides the linear difference in millimetres or fractions of a millimetre. Optical magnifications provide a high degree of precision in measurements due to the reduction of moving members and better wear-resistance qualities.

2