

Max. Marks: 180; Time: 180 Min.; VKJ/290411/ESE

NOTES:

- (I) Answers should be brief and to-the-point, and be supplemented with neat sketches if required.
- (II) **Attempt the questions in the order they are given in the question paper.**
- (III) **Start a new question (not sub-question) from a new page.**
- (IV) All matching questions should be solved as matching item of column A with items of column B, not vice versa. More than one answer may be correct / match.
- (V) Minimum marks for each question is zero.

Q.1. Part 1:

Choose the most appropriate answer.

[1X 7]

- (I) Aluminum beverage cans are produced at the rate of 10 pieces / s throughout the year. It is: (a) mass production, (b) continuous flow production, (c) batch production, (d) job shop production.
- (II) Which material does not contract during solidification: (a) mild steel, (b) aluminum, (c) C.I., (d) brass?
- (III) In case of centrifuge casting, the casting properties do not depend on: (a) molten metal temperature, (b) speed of rotation, (c) distance from the axis of rotation, (d) size of core.
- (IV) For gas welding of a copper alloy, the oxy-acetylene flame to be used should be: (a) neutral, (b) carburizing, (c) oxidizing, (d) reducing.
- (V) Primary function of the flux coating of the electrode is: (a) avoid oxidation by the atmospheric gases, (b) add alloying element, (c) stabilize the arc, (d) to help in contamination of molten metal.
- (VI) With tungsten carbide cutting tools, highest cutting speed can be used while machining: (a) stainless steel, (b) M.S., (c) aluminum, (d) brass.
- (VII) Material removal in ECM process is by: (a) ionization and shearing, (b) transfer of electrons, (c) chemical action and abrasion, (d) migration of ions towards the tool.

Part 2

- (viii) What is the main difference between permanent mold casting and pressure die casting? **[3]**
- (ix) Write an important difference between hot hardness and cold hardness of tool materials. Make a schematic diagram showing the variation in hardness with temperature for HSS and WC. **[6]**
- (x) Name (no discussion) two methods that can be used to produce metals and alloys powder. **[2]**

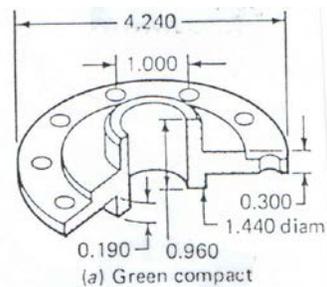
Q.2 Part-1

Choose the most appropriate answer. (a₁) A & R both are correct, (a₂) A & R both are wrong, (a₃) A is correct but R is wrong, (a₄) A is wrong but R is correct. **[2X2]**

- (i) **A:** In case of high strength materials, hot working is recommended.
R: Because of high temperature in hot working, the strength, rate of strain hardening and ductility decrease.
- (ii) **A:** Roll force bends the rolls elastically during rolling hence the strip being rolled tends to be thicker at its center than at its edges.
R: To get the plates with uniform thickness, camber is provided on the rolls.

Part – 2

- (iii) Sketch a die which can ensure uniform fill density for the part given in Fig.1, and label various elements of a die. **[4]**
- (iv) Two steels sheets of 900 μm thick are spot welded at a current of 5×10^3 A for a period of 0.1 s by an electrode of diameter = 5×10^{-3} m. Estimate the total heat generated and its distribution in percent (i.e. heat utilized for melting and dissipated in the surrounding). Take effective resistance as 200 μΩ and nugget volume = 30×10^{-9} m³. Steel density = 8000 kg/m³, Specific melting heat required = 1400 J/g. **[5]**
- (v) Draw a neat sketch showing different parts of extrusion set-up for making plastic pipes of square x-section using a screw type extruder. (Clearly draw the x-section of mandrel) **[5]**



Q.3.

(i) Write the type of chip produced during (a) turning of M.S., (b) grinding of C.I. (c) drilling of HSS, [3]

(ii). Match the following. [1x9]

A	B
(a ₁) Filler Metal	(b ₁) Economic health of a country
(a ₂) Flux	(b ₂) Explosive welding
(a ₃) 15 V - 45 V	(b ₃) Resistance spot welding
(a ₄) Cutting tool fails	(b ₄) Good for joining dissimilar metals
(a ₅) Tungsten electrode	(b ₅) Friction welding
(a ₆) $I^2Rt = \text{heat produced}$	(b ₆) Over a range of temperature
(a ₇) Rotational speed of the workpiece affects	(b ₇) Non-consumable
(a ₈) Ultrasonic welding	(b ₈) Gaseous shield around the weld zone
(a ₉) Manufacturing activity relates to	(b ₉) Supplies additional material to the weld zone
	(b ₁₀) Plastic deformation

(iii) Choose the most appropriate answer / fill in the blanks. [1x6]

A: Shear angle is the angle between (a) shear plane and the machined surface, (b) shear plane and rake face of the tool, (c) rake face of the tool and the vertical plane, (d) shear plane and horizontal plane.

B: The mechanism of metal removal in EDM is (a) brittle fracture, (b) shear deformation, (c) anodic dissolution, (d) melting and vaporization.

C: In centerless grinding, the workpiece is supported (a) on a magnetic chuck, (b) between centers, (c) on an universal chuck, (d) blade.

D: Can you use "Screw type extruder molding set-up" for making brass parts? (a) Yes, (b) No.

E: Process used to make mineral water bottle.....

F: The operation in which metals are subjected to a controlled cycle of heating and cooling is known as...

Q.4.

(i) Austenite ($>725^{\circ}\text{C}$) is cooled to room temperature by (a) water quenching, (b) air cooling, and (c) furnace cooling. Answer the following: (a₁) Which will have high ductility?, (a₂) Which will have fine pearlite?, (a₃) Which will have highest wear resistance? [3]

(ii) A mild steel workpiece of 120 mm diameter is to be turned using HSS tool. Some of the spindle speeds available on the lathe machine are 90, 114, 155, 200, 250, 320, 400 and 500 RPM. The tool life exponent of the Taylor's tool life equation is 0.6 and the value of the machining constant is 700. What is the highest spindle speed that the operator should choose for 60 minutes tool life (take cutting speed in m/min and tool life in min.)? [6]

(iii) Choose the most appropriate answer. [1X3]

(A) The machining action in USM is achieved by (a) impact of tool on workpiece, (b) impact of tool on abrasive particles, (c) impact of tool on the coolant, (d) none of the these.

(B) Machinability in metal cutting depends on : (a) tool life, (b) tool material properties, (c) workpiece material properties, (d)all of the these.

(C) The operation required for improving cutting action of a grinding wheel is called: (a) trueing, (b) dressing, (c) loading, (d) glazing.

(iv) Answer should be brief and to the point. [3X2]

(a) Define apparent density and true density for powder metallurgy parts.

(b) Why gears and bearings are more suited to be made by powder metallurgy route?

Q.5.

(i) Differentiate between glazing and loading of a grinding wheel. [3]

(ii) Make the diagrams showing the following weld defects: inclusion, incomplete penetration, underfill. [3]

(iii) Draw a figure showing the various elements of flank wear and crater wear. [2]

(iv) Show that for orthogonal machining with zero degree rake angle tool, the rate of heat generation in metal cutting in primary shear deformation zone can be expressed as $F_c V_c (1 - \mu r_c) / J$ [10]

where, F_c =cutting force, V_c =cutting speed, μ =coefficient of friction, r_c =chip thickness ratio, and J =mechanical equivalent of heat. Assume that whole of the work done in PSDZ is converted into heat.

Q.6.

(i) Match the following.

[1x8]

(A)

- (a₁) Higher productivity
- (a₂) Riser
- (a₃) Grains grow
- (a₄) Porosity
- (a₅) Chills
- (a₆) sheet metal shearing
- (a₇) Barreling
- (a₈) Rivets

(B)

- (b₁) Affects ductility, surface finish & strength
- (b₂) Affects rate of cooling in specified zones
- (b₃) Clearance between punch and die
- (b₄) Open die forging
- (b₅) Optimize use of men, material, machine and money
- (b₆) Provides material to take care of shrinkage
- (b₇) Direction opposite to heat transfer
- (b₈) Heading operation

(ii) Derive a relationship (in terms of known quantities) to determine mean chip thickness (t_m) obtainable during cylindrical grinding. [10]

Q.7.

(i) A single point tool is used with a chip breaker. How does a chip breaker help in improving the surface quality (or surface finish) of the product? Will you recommend the use of a chip breaker while turning C.I.? [4]

(ii) Suppose a single point cutting tool is machining a job of 120 mm diam. at 150 RPM. Its tool life is estimated as 7.5 minutes. When it is turning another job of the same material of 85 mm diam. at 50 RPM, its tool life is estimated as 75 minutes. Find the constant and tool life exponent of Taylor's tool life equation. [6]

[1x8]

(iii) Match the following:

(A)

- (a₁) Post casting operation
- (a₂) Shell molding
- (a₃) Wax
- (a₄) Permanent mold casting
- (a₅) Pressure die casting
- (a₆) Hot working
- (a₇) Warm working
- (a₈) Cold working

(B)

- (b₁) Pattern material
- (b₂) Gravity feed
- (b₃) 20 – 70 MPa
- (b₄) < 0.3 T_m
- (b₅) Machining & Finishing
- (b₆) Connecting rods
- (b₇) 0,4T_m
- (b₈) > 0.6 T_m

Q.8.

(i) Choose the most appropriate answer / fill in the blanks . [1X4]

- (A) Negative rake angle on the cutting tool is provided for: (a) reducing cutting forces, (b) improving dimensional accuracy, (c) strengthening cutting tool, (d) to improve surface finish.
- (B) Tungsten carbide bar of 30 mm diam, is to be turned on a lathe machine. Which tool material will you recommend? (a) H.S.S., (b) WC, (c) alloy steel, (d) none of these.
- (C) Design a part such that it meets requirement as well as manufacturing requirements.
- (D) Bulging of a part can take place in die forging.

(ii) Choose the most appropriate answer. [2x2]

Write the appropriate answer (a) A & R both are correct, (b) A & R both are wrong, (c) A is correct and R is wrong, (d) A is wrong but R is correct.

(1) **A:** Soft grade grinding wheel is normally recommended for hard materials.

R: Soft grade grinding wheel is recommended to avoid breakage of the grinding wheel.

(2) **A:** A precision component is being machined on a lathe machine and meeting its dimensions is most important. Hence crater wear is used as a tool failure criterion.

R: Crater wear is used as a tool failure criterion because it does not affect the dimensions of the machined component.

(iii) Derive a relationship in terms of known / measurable quantities to determine shear angle (ϕ), and using this relation, write the conditions for which the following equation is true where, r_c is chip thickness ratio.

Write abbreviations what they stand for.

$$\phi = \tan^{-1}(r_c)$$

[10]

Q.9.

(i) A company uses 61 as prefix to indicate exact kind of abrasive and 32 as suffix to indicate its private marking. The grinding wheel uses rubber as the bonding material, dense structure (can be indicated as 5) and, SiC abrasive of medium size (30 mesh size). The wheel is of soft grade (take E as its symbol). Write its specifications as a standard practice. **[3]**

(ii) Make a part of the grinding wheel and workpiece to show wheel's partial loading, chip being removed, active grain, inactive grain, bond material and porosity. **[6]**

(iii) Choose the most appropriate answer: **[2x2]**
 (a₁) A and R both are correct, (a₂) A and R both are wrong, (a₃) A is correct but R is wrong, (a₄) A is wrong but R is correct.

(1) (A): ECM can not be used for machining MMC.

(R): MMC is electrically non-conducting.

(2) (A): EDM produces a surface that gives better lubricating properties.

(R): During EDM, sparking takes place between the electrodes that creates craters on the machined surface, which retain the lubricant.

(iv) Match the following. **[1X5]**

(A)	(B)
(a ₁) Conventional machining	(b ₁) Kerosene used as dielectric
(a ₂) ECM	(b ₂) used to make a turbine blade
(a ₃) EDM	(b ₃) CBN as a tool material
(a ₄) EBM	(b ₄) Nano-manufacturing
(a ₅) FIB	(b ₅) Filters for food industries

Q.10.

(A) Write True/False/Fill in the blank. **[6]**

(i). Use of Flexible internal mandrel or filling the loose sand particles are the means adopted to avoid /..... during bending of tubes.

(ii). Door and window frames of aluminum can be made by process.

(iii). Turbine blade can be finished to nanometer Ra value byprocess.

(iv). Ceramic balls can be finished to around 10 nm Ra value by

(v). To create a hole in the casting, is used.

(vi). C. I. square cross-section 1 m long pipe can be made by casting process.

(B) Prove that the specific cutting pressure in an ideal orthogonal cutting is given by $\zeta \cot \phi$, provided $2\phi + \beta - \alpha = \pi/2$ holds good where $\zeta \rightarrow$ shear stress, β is friction angle and α is back rake angle. (specific cutting pressure = cutting force / chip cross-sectional area). **[9]**

(C) Choose the most appropriate answer: **[1X3]**

(a) The continuous chip with BUE: (c₁) yields good surface finish, (c₂) yields poor surface finish, (c₃) has no effect on surface roughness.

(b) Many thousand holes (diameter = 10 μ m) per centimeter square are to be drilled at a high drilling rate (a few microseconds per hole). Which process will you recommend: (a₁) EDM, (a₂) ECM, (a₃) EBM, (a₄) USM.

(c) There are two holes A and B each of 4 mm diam, and 100 mm deep made in a M.S. block. These holes are separated by a thin wall of about 1 mm thickness. One hole is to be made across the wall to join the holes A and B at a distance of 40 mm from the top surface. Which process will you use: (a₁) EDM, (a₂) ECM, (a₃) EBM, (a₄) LBM.

GOOD LUCK