G 1973 (Pages : 2) Reg. No.....

Name.....

B.TECH DEGREE EXAMINATION, MAY 2010

Third Semester

Branch : Mechanical Engineering

FLUID MECHANICS – (M)

(Prior to 2007 Admissions – Supplementary)

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

Part A

Each question carries 4 *marks.*

1. What does the coefficient of compressibility of a fluid represent?
2. Explain metacentric height of a floating body.
3. Differentiate between the Lagrangian and Eulerian approach of fluid motion.
4. A fluid flow is describe by the velocity vector $U = 5x^2\ i - 15x^2\ y\ j$. Test the flow for rotationality.
5. Briefly explain the pressure variation across a uniform bend in a fluid flow.
6. What are the assumptions made in the derivation of Bernoulli's equation.
7. What is a stream lined body?
8. Distinguish between a laminar and turbulent boundary layer.
9. What is the significance of critical Reynold's number?
10. Explain the phenomenon of water hammer.

(10 × 4 = 40 marks)

Part B

Each question carries 12 *marks.*

11. (a) An inverted U-tube manometer using oil of specific gravity 0.8 as manometric fluid is connected to pipes A and B carrying the liquids of specific gravities 1.2 and 1 respectively. The pipes A and B are at the same level. The height of the lower level of mercury is 40 cm from the centre of pipe A. Find out the differential reading of the manometer. Assume all liquids are immiscible and the pressure in pipe B is 2000 Pa above the pressure in pipe A.

Or

Turn over

(b) Derive an expression for the total hydrostatic force acting and for the centre of pressure for a plane surface of area A immersed in water with angle of inclination θ with the free surface of water.

(12 marks)

12. (a) Derive the continuity equation for a 3-dimensional flow in Cartesian co-ordinates.

Or

(b) Explain Stream function and Velocity potential function. Express the conditions for Irrotational flow and vorticity in terms of stream and velocity potential functions.

(12 marks)

13. (a) Explain the momentum and energy correction factors.

Or

(b) A pipe of 30 cm diameter inclined 30° to the horizontal is carrying gasoline of specific gravity 0.82. A venturimeter is fitted in the pipe to find out the flow rate whose throat diameter is 15 cm. The throat is 1.2 m from the entrance along its length. The pressure gauges fitted to the venturimeter read 140 kN/m^2 and 80 kN/m^2. (i) Find out the discharge through the pipe if C_d of venturimeter is 0.96 ; (ii) If a U-tube manometer containing mercury is used to measure pressure find out the difference in mercury levels if the flow is towards the upward direction.

(12 marks)

14. (a) Derive the Navier Stoke equations for the motion of a viscous fluid.

Or

(b) With sketches, explain the nomenclature of an Aerofoil. Discuss the flow around an aerofoil and write the expressions for drag and lift forces on it.

(12 marks)

15. (a) Water is flowing over a flat plate 2 m × 1.5 m with a velocity of 0.25 m/sec. The flow is parallel to 2m side. Find the thickness of boundary layer and shear stress at 1.4 m from the leading edge of the plate. Take dynamic viscosity of water as 0.0001 Ns/m^2. Also find the total drag force on one side of the plate.

Or

(b) (i) Derive an expression for the power transmission through a pipe carrying water and get the condition for maximum efficiency.

(ii) Write notes on Siphon and Moody's Chart.

(7 + 5 = 12 marks)

[5 × 12 = 60 marks]

G 1981 (Pages : 2) Reg. No.....

Name.....

B.TECH DEGREE EXAMINATION, MAY 2010

Third Semester

Branch : Mechanical Engineering and Automobile Engineering

METALLURGY AND MATERIAL SCIENCE (MU)

(Prior to 2007 Admissions – Supplementary)

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*

Each question carries 4 *marks.*

1. What is meant by polymorphism? Give some of its examples.
2. Explain Fick's second law of diffusion.
3. Discuss the effect of grain size on mechanical properties of metals.
4. Explain a eutectoid system.
5. What factors affect the choice of cooling rates for steels?
6. What is grain boundary hardening?
7. State the effects of important alloying elements ion steel.
8. Write short notes on : (i) High speed steel ; (ii) Babbbitt metal.
9. What is a cleavage fracture?
10. Explain the effect of surface texture on fatigue failure.

(10 × 4 = 40 marks)

Part B

Each question carries 12 *marks.*

11. (a) (i) Explain cystallographic directions. Sketch the following planes and directions (123), $(00\bar{1})$ (101), $(\bar{1}\bar{1}1)$, (121), (111).

(ii) What is a line defect?

(9 + 3 = 12 marks)

Or

(b) Explain edge and screw dislocation with the help of Burger's circuit. Mention the role of dislocation in the deformation of metals.

Turn over

12. (a) What is lever rule? With a neat sketch explain the equilibrium diagram for binary systems showing complete inter solubility in the liquid and solid states.

Or

(b) Draw a neat sketch of the $Fe–Fe_3C$ equilibrium diagram. Label all significant features and explain the three important reactions.

(12 marks)

13. (a) Explain (i) Spherodizing ; (ii) Austempering ; (iii) Martempering ; (iv) Normalizing ; (v) Annealing.

Or

(b) With sketches explain the flame hardening and induction hardening methods of surface treatment. How does metal spraying and metal cladding improve surface properties?

(12 marks)

14. (a) Give the composition, microstructure, properties and applications of (i) Grey cast iron ; (ii) Malleable cast iron ; (iii) Spheroidal graphite cast iron.

Or

(b) (i) Explain magnetic alloys and stainless steels.

(ii) Explain the composition and uses of important aluminium alloys.

(6 + 6 = 12 marks)

15. (a) With a neat sketch explain the method of conducting a typical creep test. Draw the typical creep curve for a metal and explain the different regions on it.

Or

(b) (i) Explain Griffith crack theory.

(ii) Distinguish between a ductile and brittle fracture.

(6 + 6 = 12 marks)

[5 × 12 = 60 marks]

G 1988 (Pages : 2) Reg. No.....

Name.....

B.TECH DEGREE EXAMINATION, MAY 2010

Third Semester

Branch : Mechanical Engineering and Automobile Engineering

THERMODYNAMICS (MU)

(Prior to 2007 Admissions –Supplementary)

Time : Three Hours Maximum : 100 Marks

Use of steam tables and psychrometric chart are permitted.

Part A

Answer **all** *questions.*
Each question carries 4 *marks.*

1. Explain the different types of thermodynamic systems.
2. What is quasi-static process and how does it differ from a reversible process?
3. What is a thermocouple? State its advantages.
4. What is Joule-Thompson effect?
5. Explain the processes of a carnot cycle.
6. Describe available and unavailable energy.
7. Define the Helmholtz function and Gibbs free energy.
8. What assumptions are made in obtaining the Clausius-Clapeyron equation from Clapeyron equation?
9. What is a Mollier diagram and what are its uses?
10. What is dew point temperature?

(10 × 4 = 40 marks)

Part B

Each question carries 12 *marks.*

11. (a) What is an indicator diagram?
    (b) A certain fluid at 10 bar is contained behind a piston, the initial volume being 0.05 m^3. Calculate the work done by the fluid when it expands reversibily (i) at constant pressure to final volume of 0.2 m^3 (ii) according to law pV = constant to a final volume of 0.06 m^3. Also sketch the processes on p-V diagram.

(12 marks)

Or

12. (a) Explain compressibility Chart.
    (b) What is the concept of continuum? Define Density and pressure using this concept.

Turn over

(6 + 6 = 12 marks)

13. What is control volume concept? Develop the equation for the energy balance for a steady flow of a fluid through a control volume.

Or

14. (a) What is Zeroth law of temperature?

(b) Gas enters at the rate of 4 kg/s in a gas turbine with a velocity of 55 m/s and enthalpy of 1000 kJ/kg and leaves the turbine with a velocity of 150 m/s and enthalpy 500 kJ/kg. There is a heat exchange with the surroundings which is estimated to be 25 kJ/kg. Assume for gas R = 0.287 kJ/kgK and C_P = 1.004 kJ/kgK and the inlet conditions to be at 100 kPa and 27°C. Determine the power output of the turbine and the diameter of the inlet pipe.

(3 + 9 = 12 marks)

15. State the Clausius and Kelvin-Plank statements of the second law of Thermodynamics and prove that they are equivalent.

(12 marks)

Or

16. (a) Explain Clausius inequality.

(b) A Carnot heat pump operates between the temperature levels – 5° C and 25° C. If the power consumption of the heat pump is 5 kW, determine the Coefficient of performance and the rate at which energy is rejected at 25° C.

(6 + 6 = 12 marks)

17. (a) Prove that $Tds = Cv \left(\frac{\partial T}{\partial P}\right) dp + C_p \left(\frac{\partial T}{\partial V}\right)_p dv$.

(b) Show that the internal energy of an ideal gas is a function of temperature only.

(6 + 6 = 12 marks)

Or

18. (a) Derive the equation : $\left(\frac{\partial C_P}{\partial P}\right)_T = - T \left(\frac{\partial^2 V}{\partial T^2}\right)_p$.

(b) Show that C_v of an ideal gas depends on temperature only.

(6 + 6 = 12 marks)

19. Explain : (i) Dalton's law of partial pressure ; (ii) Adiabatic saturation temperature ; (iii) Cooling tower ; (iv) PVT surface.

Or

20. (a) Steam at 150 bar has an enthalpy of 3309 kJ/kg, find the temperature, specific volume and the internal energy.

(b) Show the following process on a psychrometric chart : (i) Sensible heating ; (ii) Chemical dehumidification.

(7 + 5 = 12 marks)

[5 × 12 = 60 marks]

G 1995 (Pages : 2) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2010

Third Semester

Branch : Mechanical, Polymer Engineering and Automobile Engineering

STRENGTH OF MATERIALS AND STRUCTURAL ENGINEERING (MPU)

(Prior to 2007 Admissions – Supplementary)

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

Assume any missing data suitably.

Part A

Each question carries 4 *marks.*

1. A rod is inserted inside a tube of different material but of the same length. The ends of the composite rod are fixed at the ends. Derive the temperature stresses developed in both rod and tube due to a temperature change of T° C with usual notations.
2. Derive the relation between Young's modulus and Rigidity modulus.
3. Draw the shear force and bending moment diagram for a cantilever beam with a u.d. load of intensity w acting over the half span from the free end.
4. Derive the relation $\frac{M}{I} = \frac{f}{y}$.
5. Explain what is meant by a conjugate beam.
6. Find the slope and deflection at the free end of a cantilever beam with a point load P at the center of span. The flexural rigidity of the cantilever is EI.
7. What are the assumptions made in the theory of pure torsion?
8. Obtain the expressions for strain energy stored in a prismatic bar due to generally applied and suddenly applied axial load.
9. Give the 'equivalent length' for a column with different end conditions.
10. Sketch the typical reinforcement details for a cantilever beam.

(10 × 4 = 40 marks)

Part B

Each question carries 12 *marks.*

11. A steel bar 50 mm in diameter and 2 m long is firmly encased in a shell of cast iron 5 mm thick. Compute the stress in each material if a composite axial load of 200 kN is applied to the assembly. For steel E = 200 GPa, and for cast iron E = 100 GPa.

Or

12. A material is subjected to two mutually perpendicular direct stresses of 80 MN/m^2 tensile and 50 MN/m^2 compressive, together with a shear stress of 30 MN/m^2. The shear couple acting on planes carrying the 80 MN/m^2 stress is clockwise in effect. Draw the Mohr's circle for the above state of stresses (need not be to scale) and get the magnitude and nature of principal stresses and maximum stresses.

13. A beam ABCDE , with A on the left, is 6 m long and is simply supported at B and E. The lengths of various portions are AB = 1.5 m, BC = 1.5 m, CD = 1 m, DE = 2 m. There is a uniformly distributed load of 15 kN/m between B and a point 2 m to the right of B and concentrated loads of 30 kN act at A and D. Draw the shear force and bending moment diagram showing their maximum values.

Or

14. Determine the shear stress variation along the depth of a beam with a channel cross section having a uniform thickness of 10 mm for the web and flanges. The total height of the section is 200 mm and overall width of each flange is 100 mm. The shear force is 150 kN.

15. A simply supported beam AB is 7 m long and carries a uniformly distributed load of 30 kN/m run. A couple is applied to the beam at point C, 2.5 m from the left hand end A, the couple being clockwise in sense and of magnitude 70 kNm. Calculate the slope and deflection at point D, 2 m from the left end. Take $EI = 5 \times 10^7\ Nm^2$.

Or

16. A simply supported beam has a span of 6 m and carries a distributed load which varies in a linear manner from 20 kN/m at one support to 60 kN/m at the other support. Find the maximum deflection and its location.

17. A bar ABD, 2 m long, has a circular cross section of 75 mm diameter over half its length AB and 50 mm diameter over the remaining half BD of its length. The ends A and D are held rigidly by immovable supports. A torque of 1 kNm is applied at C midway between B and D. Calculate the maximum shear stress and the maximum angle of twist in the bar : G = 70 GPa.

Or

18. A cylinder of 100 mm internal radius and 125 mm external radius is subjected to an external pressure of 14 MN/m^2. What will be the maximum stress set up in the cylinder?

19. A tubular column has an effective length of 2.5 m and is to be designed to carry a safe load of 300 kN. Assuming an approximate ratio of thickness to external diameter of 1/16, determine a practical diameter and thickness using the Rankine formula with $\sigma_s = 330\ N/mm^2$ and $\alpha = 1/7500$. Use a safety factor of 3.

Or

20. A circular concrete column, of 300 mm diameter, is designed with six numbers of 16 mm diameter longitudinal steel bars and 6 mm diameter lateral ties spaced at 75 mm center to center. Prepare a sketch of (i) Plan and (ii) Sectional elevation of the column.

(5 × 12 = 60 marks)

G 1962 (Pages : 3) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2010

Third Semester

Branches : Civil, Mechanical, Electrical and Electronics, Electronics and Communication, Applied Electronics and Instrumentation, Instrumentation and Control, Electronics and Instrumentation, Automobile Engineering

ENGINEERING MATHEMATICS—II (CMEPLANSU)

(Prior to 2007 admissions)

[Supplementary]

Time : Three Hours Maximum : 100 Marks

Answer **one** *full question from each module.*
Each full question carries 20 *marks.*

Module 1

1. (a) Find the directional derivative of $\phi = 4xz^3 - 3x^2y^2z$ at $(2, -1, 2)$ in the direction of $2\vec{i} - 3\vec{j} + 6\vec{k}$. (5 marks)

(b) Find the value of λ if the vector $\left(\lambda x^2 y + yz\right)\hat{i} + \left(xy^2 - xz^2\right)\hat{j} + \left(2xyz - 2x^2y^2\right)\hat{k}$ has zero divergence. Also find the curl of the above vector when it has zero divergence. (8 marks)

(c) If n is a non-zero constant, show that $\nabla^2 r^n = n(n+1)\, r^{n-2}$. (7 marks)

Or

(d) $\vec{\nabla} = \vec{w} \times \vec{r}$, where $\vec{w}$ is a constant vector show that, $\vec{w} = \frac{1}{2}\text{curl } \vec{\nabla}$. (5 marks)

(e) If U and V are differentiable scalar fields, prove that $\nabla U \times \nabla V$ is solenoidal. (8 marks)

(f) If $r = |\vec{r}| = \sqrt{x^2 + y^2 + z^2}$, prove that $\nabla f(r) = \frac{\vec{r}}{r} \cdot \frac{df}{dr}$ and hence find ∇r^n. (7 marks)

Module 2

2. (a) Find the total work done in moving a particle in a force field : $f = 3xy\,\vec{i} + y\vec{j} + 2xz\vec{k}$ once round the circle in the xy-plane whose centre is at the origin and radius equal to 2 units. (5 marks)

Turn over

(b) Using divergence theorem, prove that $\iiint_V \nabla\phi\, dV = \iint_S \phi \cdot \vec{n}\, dS$. (15 marks)

Or

(c) Using Green's theorem in the plane, evaluate $\oint_C \left(3x^2 - 8y^2\right) dx + (4y - 6xy)\, dy$ where C is the boundary of the region enclosed by $y = \sqrt{x}$ and $y = x^2$. (15 marks)

(d) Find $\int_C \overline{A} \cdot d\vec{r}$ along the curve C defined by $x = t^2 + 1$, $y = 2t^2$, $z = t^3$ from $t = 1$ to $t = 2$, where $\overline{A} = 3xy\,\hat{i} - 5z\,\hat{j} + 10x\,\hat{k}$. (5 marks)

Module 3

3. (a) Show that $z\bar{z}$ is differentiable but not analytic at the point $z = 0$. (5 marks)

(b) Obtain the Cauchy-Riemann equations of a function $f(z) = u(x, y) + iv(x, y)$ in Cartesian form. (7 marks)

(c) If u and v are harmonic functions, show that $u_y - v_x + i\left(u_x + v_y\right)$ is analytic function. (8 marks)

Or

(d) If $f(z) = u + iv$ is analytic function, prove that $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$ and $\frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$. (5 marks)

(e) Discuss the transformation $w = \sin z$. Find the mappings of $z = a$ and $y = b$ in the z-plane to the w-plane. (7 marks)

(f) Find the bilinear transformation which maps $z = 0, -i, -1$ to $W = i, 1, 0$ respectively. (8 marks)

Module 4

4. (a) Using divided difference interpolation formula find the cubic polynomial that approximates y. The table of corresponding values of x and y is given below :

x :	0	1	2	5
y :	2	3	12	147

(10 marks)

(b) Using Stirling's formula, find $f(28)$ from the following data :—

x :	20	25	30	35	40
$f(x)$:	49225	48310	47232	45284	44305

(10 marks)

Or

(c) Applying Newton's backward difference formula, obtain a polynomial of degree 4 in x :

x :	1	2	3	4	5
y :	1	−1	1	−1	1

(10 marks)

(d) In the table below, the values of y are consecutive terms of a series of which 36.2 is the 7th term. Evaluate the first and tenth terms of the series :

x :	3	4	5	6	7	8	9
y :	4.8	8.4	14.4	23.3	36.2	50.8	71.4

(10 marks)

Module 5

5. (a) Calculate the value of $\int_0^{\pi/2} \sin x\, dx$ by (i) Trapezoidal rule ; (ii) Simpson's $\frac{1}{3}$ rule, using 11 ordinates, in both cases. (12 marks)

(b) A curve is drawn to pass through the points given by the following table :—

x :	1	1.5	2	2.5	3	3.5	4
y :	2	2.2	2.7	2.8	3	2.5	2.1

Estimate the area bounded by the curve, z-axis and the lines $x = 1$, $x = 4$. (8 marks)

Or

(c) A rod is rotating in a plane. The following table gives the angle θ in radians through which the rod has turned for various values of the time t second :

t :	0	0.2	0.4	0.6	0.8	1.0	1.2
θ :	0	0.12	0.44	1.12	2.02	3.40	4.67

Calculate the angular velocity and the angular acceleration of the rod, when $t = 0.6$ second. (12 marks)

(d) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by Simpson's rule taking $h = \frac{1}{4}$. Hence compute an approximate value of π. (8 marks)

[5 × 20 = 100 marks]

G 1965 (Pages : 3) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2010

Third Semester

Branch : Mechanical Engineering and Automobile Engineering

MACHINE DRAWING – I (MU)

(Prior to 2007 Admissions – Supplementary)

Time : Three Hours Maximum : 100 Marks

Missing dimensions, if any may suitably assumed.
Drawing sheets will be supplied.

Answer **all** *questions.*

1. Answer any *two* of the following :–
   (a) Sketch the elevation of an eye end type foundation bolt.
   (b) Draw the two views of a castle nut with a split pin.
   (c) Make a complete cross sectional view of the T-joint formed by welding two plates of thickness 10 mm each. Throat size of the fillet weld is 8 mm. Also represent the joint as per BIS.

   (2 × 7½ = 15 marks)

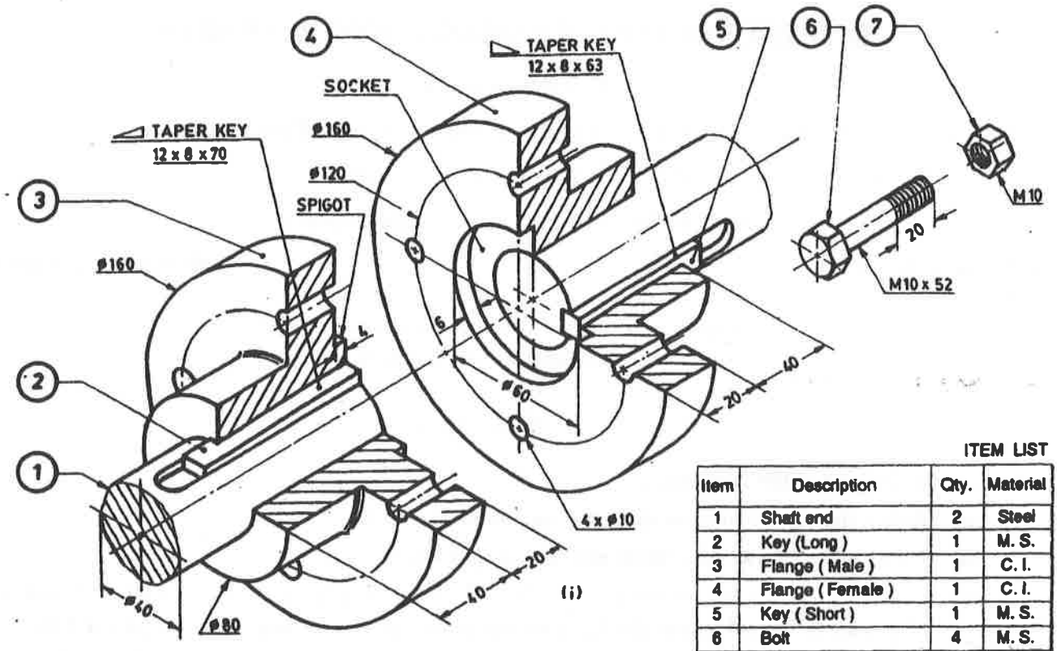
2. Fig.1 (page 2) shows the details of an unprotected type flange coupling. Draw the following views to full scale.
   (a) Half sectional front view.
   (b) Side view.

   (18 + 7 = 25 marks)

3. Fig.2 (page 3) shows the details of a box type connecting rod end of a steam engine. Assemble the parts and show.
   (a) Front view.
   (b) Side view.

   (40 + 20 = 60 marks)

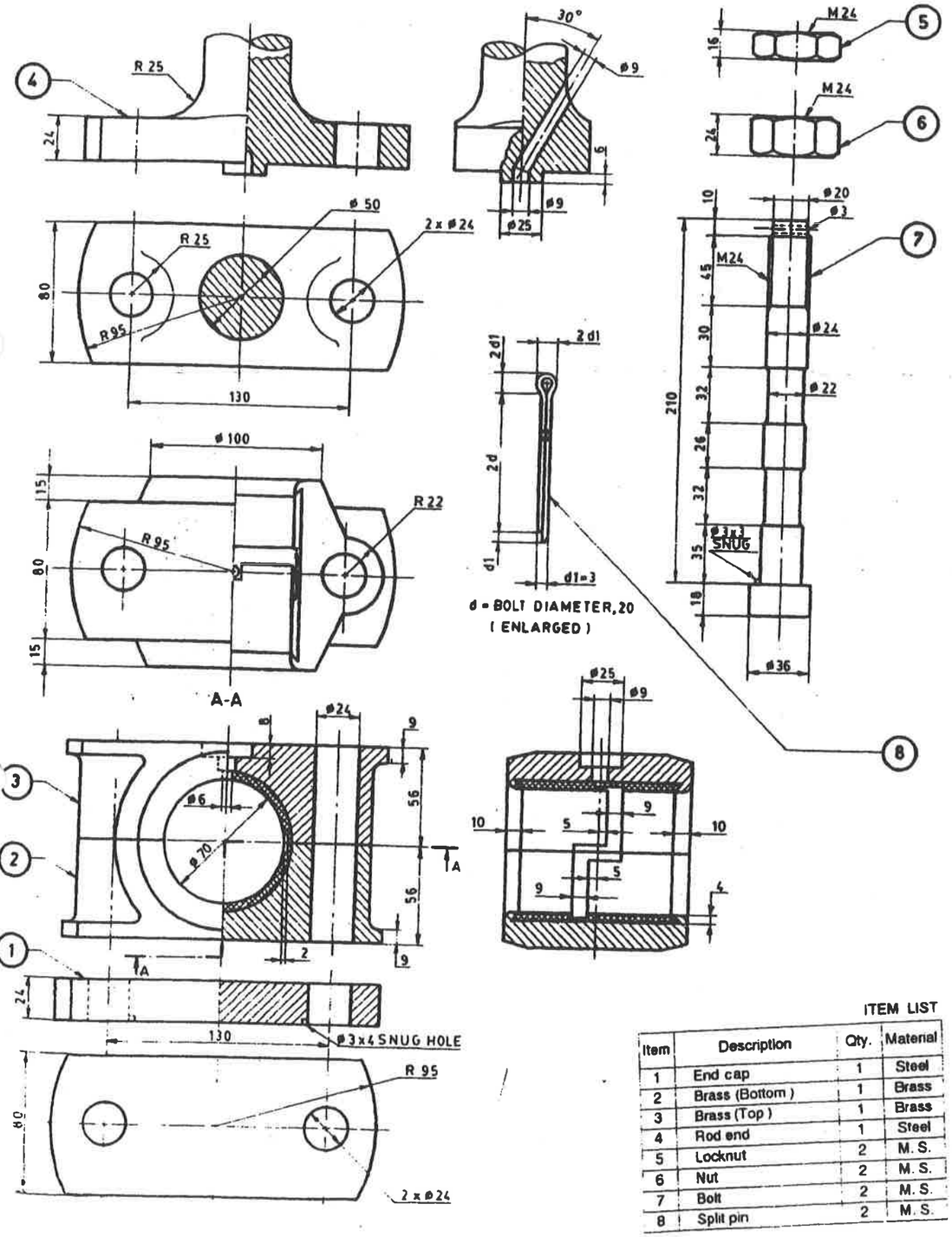
Turn over



ITEM LIST

Item	Description	Qty.	Material
1	Shaft end	2	Steel
2	Key (Long)	1	M. S.
3	Flange (Male)	1	C. I.
4	Flange (Female)	1	C. I.
5	Key (Short)	1	M. S.
6	Bolt	4	M. S.
7	Nut	4	M. S.

Fig. 1



ITEM LIST

Item	Description	Qty.	Material
1	End cap	1	Steel
2	Brass (Bottom)	1	Brass
3	Brass (Top)	1	Brass
4	Rod end	1	Steel
5	Locknut	2	M. S.
6	Nut	2	M. S.
7	Bolt	2	M. S.
8	Split pin	2	M. S.

Fig. 2