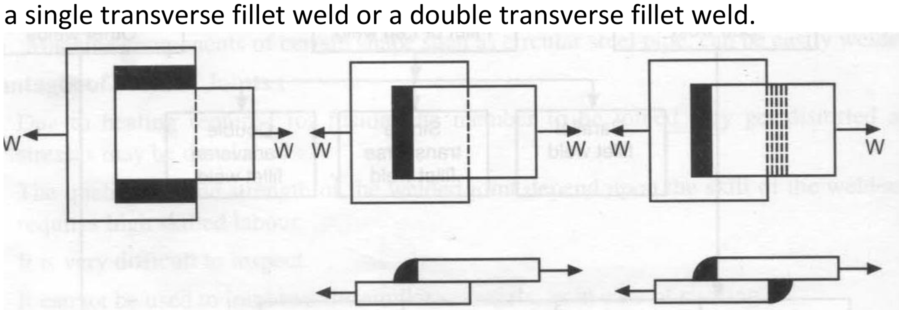
SUMMER – 16 EXAMINATIONS

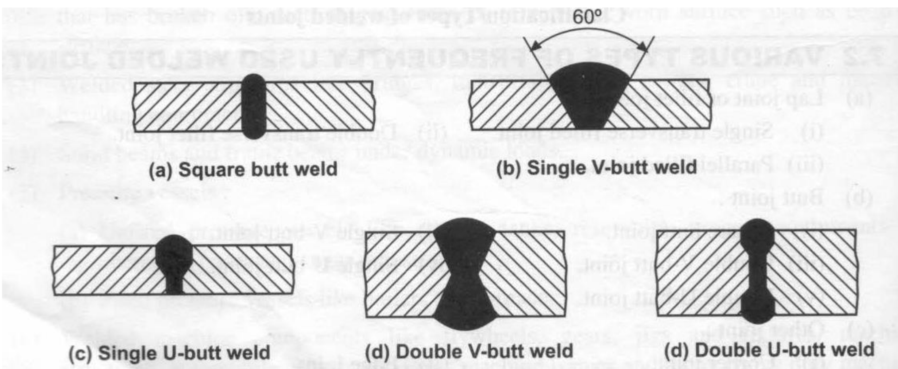
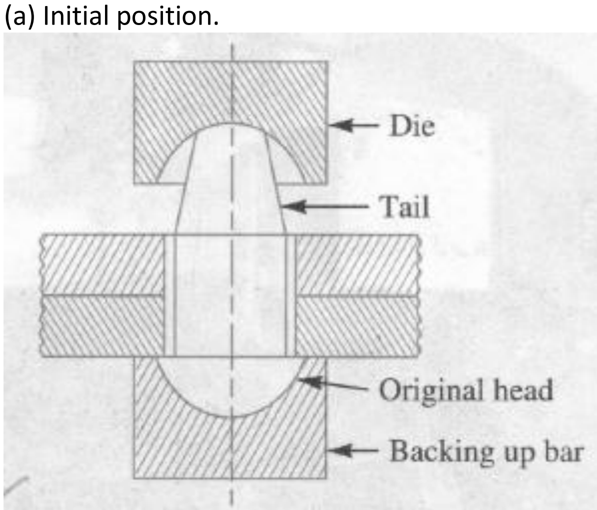
Subject Code: **17553** **Model Answer** Page No: ____/ N

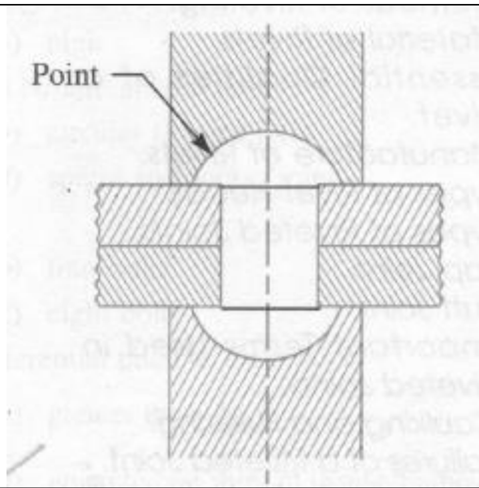
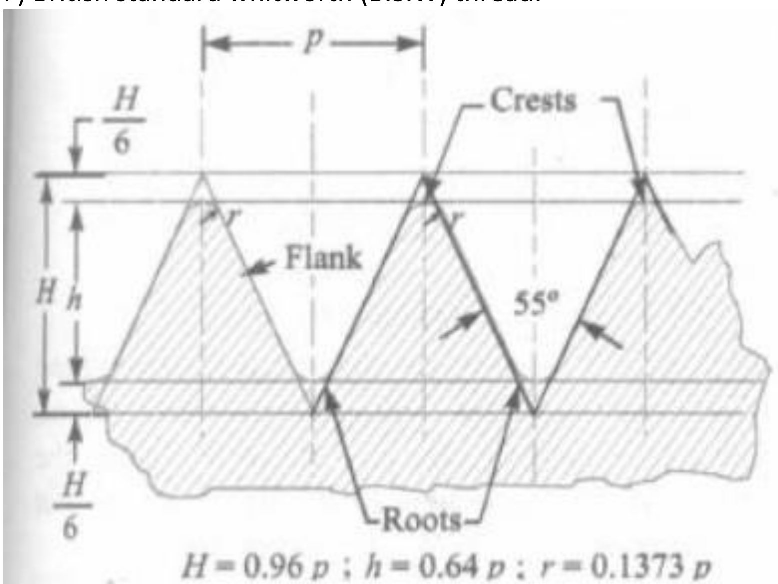
Important Instructions to examiners:

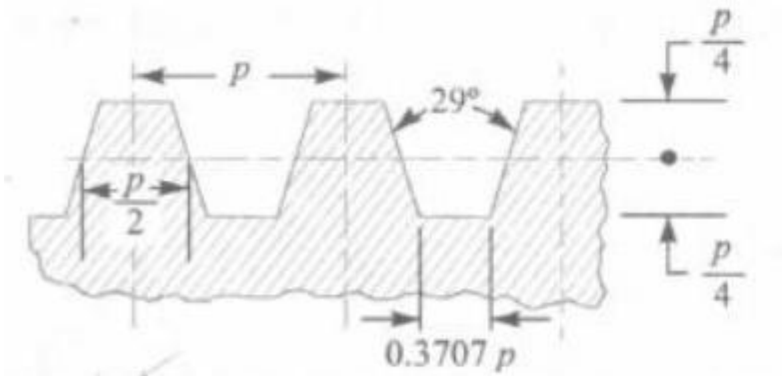
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. NO.	MODEL ANSWER	MARKS	TOTAL MARKS
1	Attempt any FIVE of the following:		5X4=20
a	ii) The general considerations in machine design are as follows. 01)Type of Load and Stresses caused by the Load:- The load on the Machine Component,may act in several ways due to which the Internal Stresses are set up. 02)Motion of Parts:- The successful operation of any Machine depends largely upon the simplest arrangements of the Parts,which will give the required motion.The Motion of the Part may be A)RectilinearMotion,which includes Unidirectional and Reciprocating Motion. B)CurvilinearMotion,which includes Rotary,Oscillatory Simple Hormonic. C)Constant Velocity. D)Constant or Variable Acceleration. 03)Selection of Material:- Every Machine Design Engineer should have a thorough knowledge of the Properties of Material and their behaviour under working conditions. 04)Form and Size of the Parts:- In order to design any Machine Part for form and size,it is necessary to know the Forces which the Part must sustain.Any suddenly applied or impact load must be taken into consideration,which may cause failure.The smallest Practicable Cross-Section may be used,but it may be checked that the Stresses induced in the Designed Cross-Section are reasonably safe. 05)Frictional Resistance and Lubrication:- There is always a Loss of Power due to Frictional Resistance.Careful attention must be given to the matter of Lubrication of all surfaces which moves in contact with others. 06)Safety of Operator:- A Machine Designer should always provide safety device for the safety of the operator.The Safety Appliances should in no way interfere with the operation of the Machine. 07)Use of Standard Parts:- The use of Standard Parts are closely related to the Cost of Machine,because the Cost of Standard Parts is only a fraction of the cost of similar parts made to order. 08)Convenient and Economical Features:- The operating feature of the Machine should be carefully studied.TheStarting,Controlling and Stopping Levers should be located on the basis of convenient handling. 09)Workshop Facilities:- A Design Engineer should be familiar with limitation of his Employer's Workshop,in order to avoid the necessity of having work-done in some other Workshop. 10)Assembling:-	01 mark each for any four points.	

	Every Machine must be Assembled as a unit before it can function.The final Location of any Machine is important and the Design Engineer must anticipate the exact location and the local facilities for erection. Above considerations are most important in machine design engineering		
b	Types of Shafts: The following two types of shafts are important from the subject point of view: 1. Transmission shafts: These shafts transmit power between the source and machines absorbing power. The counter shafts, line shafts, overhead shafts and all factory shafts are transmission shafts. Since these shafts carry machine parts such as pulleys, gears etc., therefore they subjected to bending in addition to twisting. 2. Machine shafts: These shafts form an integral part of the machine itself. The crank shaft is an example of machine shaft. The material used for shafts should have the following properties: 1. It should have high strength. 2. It should have good machinability. 3. It should have low notch sensitivity factor. 4. It should have good heat treatment properties. 5. It should have high wear resistant properties	01 mark 01 mark each for any three properties	04 marks
c	1.Lap Joint: It is a joint between two overlapping components. It consists of fillet welds. Fillet weld ishaving triangular cross-section joining two surfaces at right angles to each other. The examples of lap joint are single transverse fillet, double transverse fillet, parallel fillet welds. Based on the relative positions of the load axis with respect to the fillet axis, the fillet welds are classified intotwo types. (i) Parallel fillet weld: "If the load axis is parallel to the axis of the fillet, it is known parallel fillet weld". (ii) Transverse fillet weld : "If the load axis is perpendicular to the axis of the fillet, it is known as transverse fillet weld". The transverse fillet weld can be a single transverse fillet weld or a double transverse fillet weld.  (a) Parallel fillet weld (b) Single transverse fillet weld (c) Double transverse fillet weld 2. Butt Joint: (i) The butt weld as shown in Fig. is obtained by placing the plates to be joined side by side with their edges nearly touching each other (ii) The small gap is maintained between the edges for the filler material. (iii) The examples of butt joints are square butt, single V-butt, single If-butt,	½ mark each for any 04 figures & ½ mark each for any four applications	4m

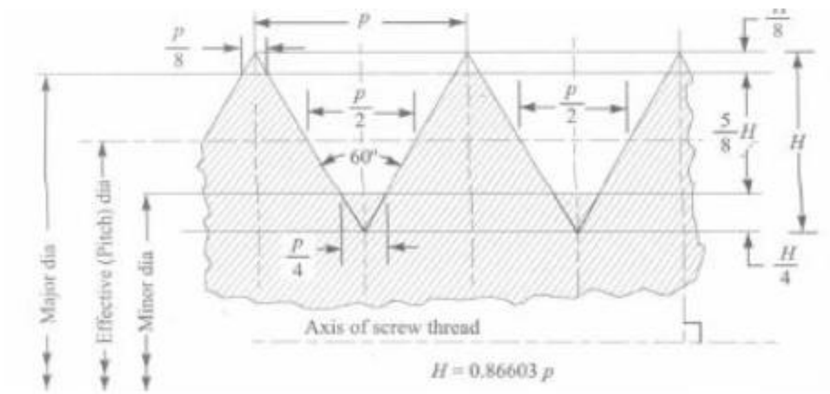
	double V-butt and double U-butt. (i) Square butt weld : If the thickness of the plates is less than 5 mm, the edge of the plates do not require bevelling and hence the joint used is known as square butt weld. (ii) Single V-butt weld or single U-butt weld: If the thickness of the plates between 5 and 12.5 mm, the edges are bevelled to V or V groove and accordingly single V-butr or single V-butt weld may be used. (iii) Double V-butt weld or Double If-butt weld : If the thickness of the plates is more than 12.5 mm, it is necessary to bevel and weld the plates from both sides. In such cases, double V -butt or double U'-butt welds are used  Butt weld		
d	The plates are drilled together and then separated to remove any burrs or chips so as to have a tight flush joint between the plates. A cold rivet or a red hot rivet is introduced into the plates and thepoint (i.e. second head) is then formed, When a cold rivet is used, the process is known as cold riveting and when a hot rivet is used, the process is known as hot riveting. The cold riveting process is used for structural joints while hot riveting is used to make leak proof joints. (a) Initial position.  (b) Final position.		

	 		
e	i) British standard whitworth (B.S.W) thread:  This is a British standard thread profile and has coarse pitches. It is a symmetrical V-thread in which the angle between the flankes, measured in an axial plane, is 550These threads are found on bolts and screwed fastenings for special purposes.The various proportions of B.S.W. threads are shown in Fig. ii)Acme thread	01 mark	



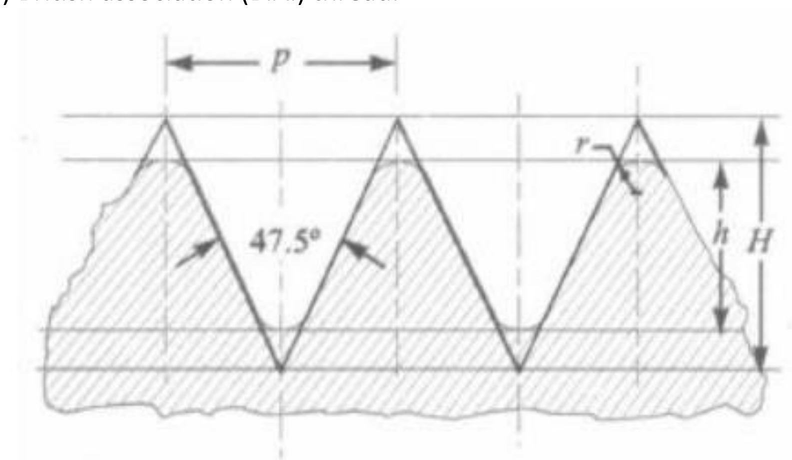
It is a modification of square thread. It is much stronger than square thread and can be easily produced. These threads are frequently used on screw cutting lathes, brass valves,cocks and bench vices.

iii) Metric Threads

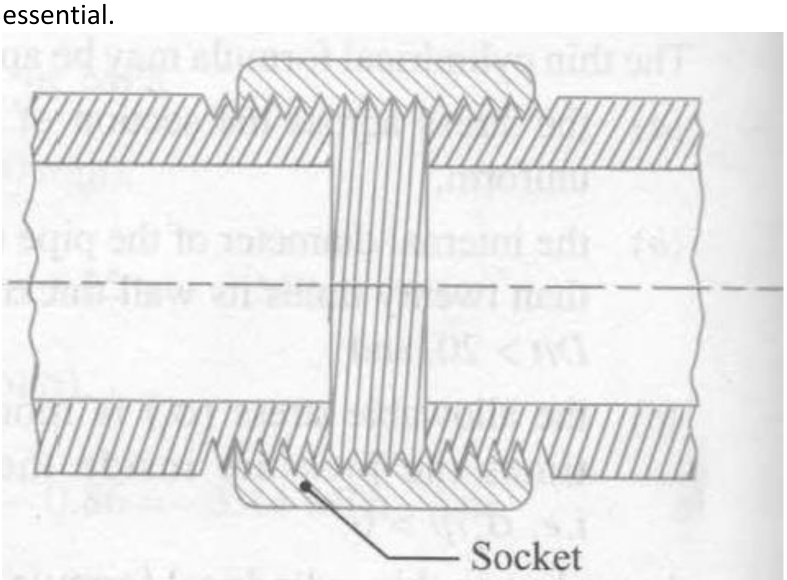


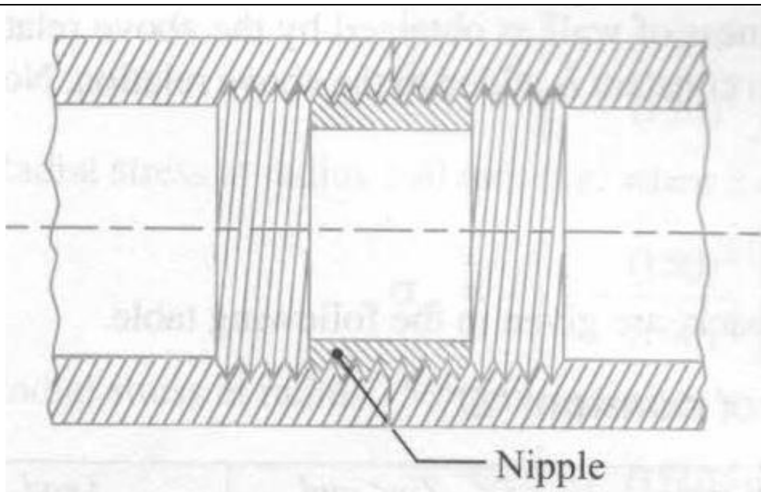
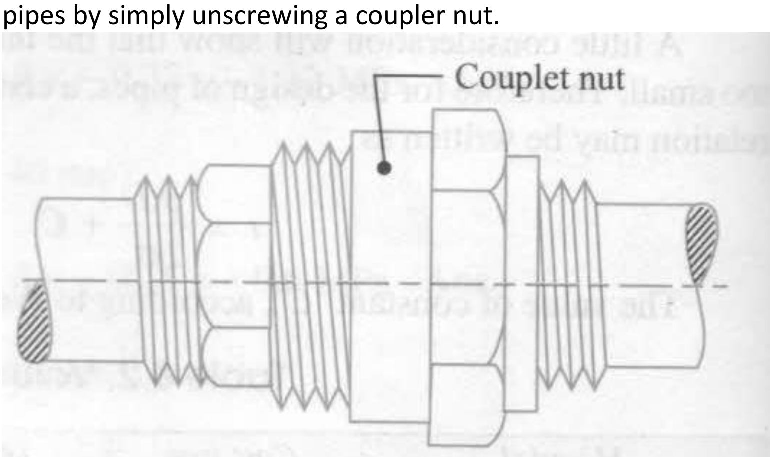
It is an Indian standard thread and is similar to B.S.W. threads. It has an included angle of 60° instead of 55°. The basic profile of the thread is shown in Fig.a and the design profIle of the nut and bolt is shown in Fig.

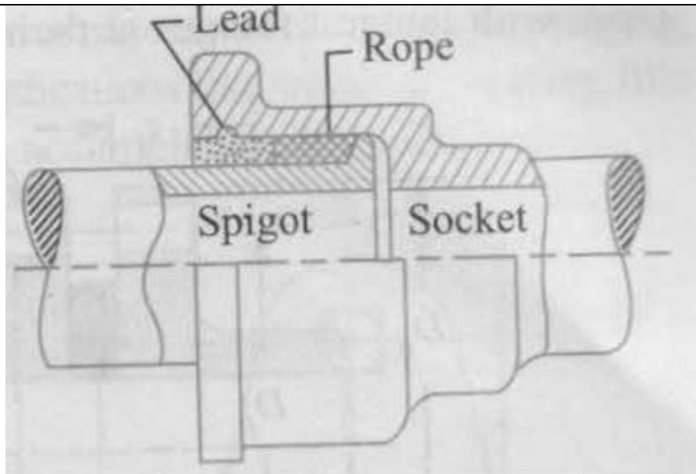
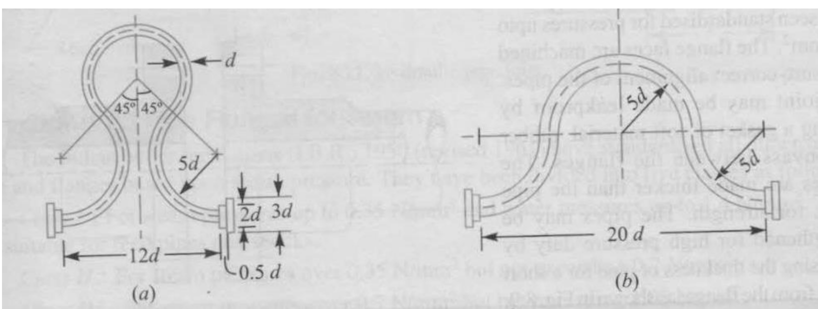
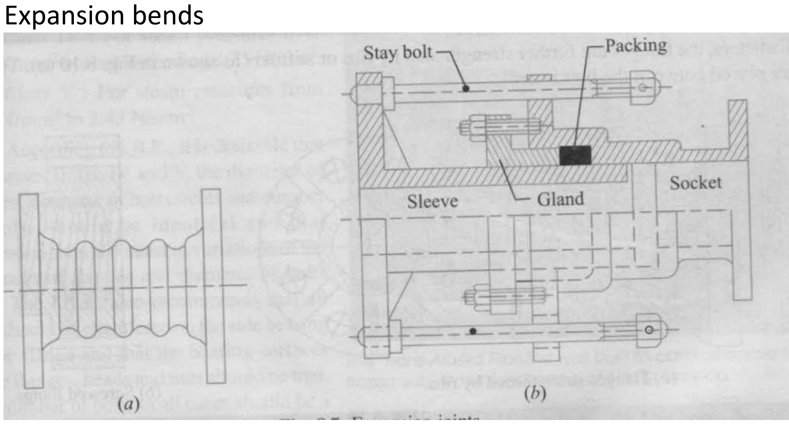
iv) British association (B.A.) thread.



$H = 1.13634\,p$; $h = 0.6\,p$; $r = 0.18083\,p$

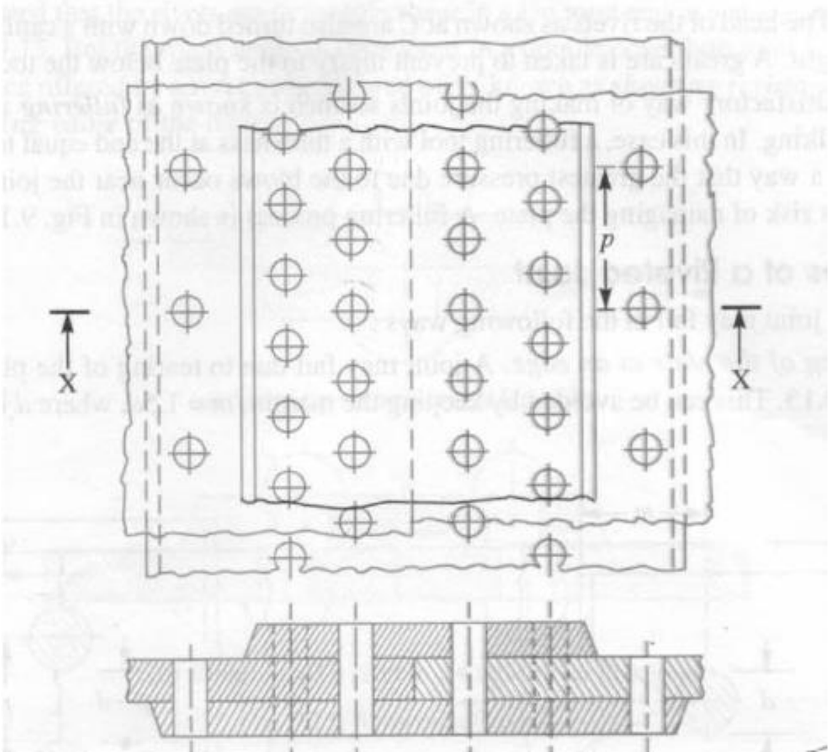
	This is a B.S.W. thread with fine pitches. The proportions of the B.A. thread are shown in Fig. These threads are used for instruments and other precision works.		
f	Stresses in Pipes:The stresses in pipes due to the internal fluid pressure are determined by Lame's equation.According to Lame's equation, tangential stress at any radius x $\sigma t =\{[p (ri)^2] / [(ro)^2 -(ri)^2] \} /\{1 +[(ro)^2 / x^2]\}$ And Radial stress at any radius x $\sigma r =\{[p (ri)^2] / [(ro)^2 -(ri)^2] \} /\{1 - [(ro)^2 / x^2]\}$ where p = Internal fluid pressure in the pipe, ri = Inner radius of the pipe, and ro = Outer radius of the pipe The various types of pipe joints are as follows. 1. Socket or a coupler joint. The most common method of joining pipes is by means of a socket or a coupler as shown in Fig. This type of joint is mostly used for pipes carrying water at low pres ure and where the overall smallness of size is most es essential.  Socket or coupler joint 2. Nipplejoint. In this type of joint, a nipple which is a small piece of pipe threaded outside' screwed in the internally threaded end of each pipe, as shown in Fig. The disadvantage of this joint is that it reduces the area of flow	02 marks for stresses 04 marks for any 4 joints & 02 marks for their applications (uses)	8m

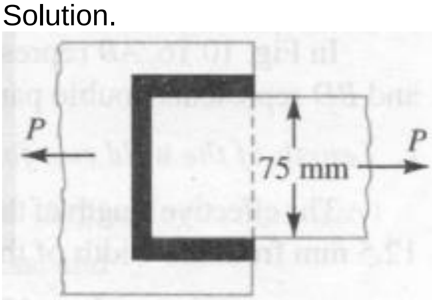
	 Nipple joint. 3.Unionjoint. In order to disengage pipes joined by a socket, it is necessary to unscrew pipe from one end. This is sometimes inconvenient when pipes are long. The union joint, as shown in Fig. provide the facility of disengaging the pipes by simply unscrewing a coupler nut.  Union joint 4. Spigot and socket joint. A spigot and socket joint as shown in Fig. , is chiefly used for pipes which are buried in the earth.		

	 Spigot and socket joint 5. Expansion joint. The pipes carrying steam at high pressures are usually joined by means of expansion joint. This joint is used in steam pipes to take up expansion and contraction of pipe line due to change of temperature  Expansion bends  Expansion joints		
g	Perfect frame : A pin-jointed frame which has got just sufficient number of members to resist the loads without undergoing appreciable deformation in shape is called rigid or perfect frame. The perfect frame obeys the following		

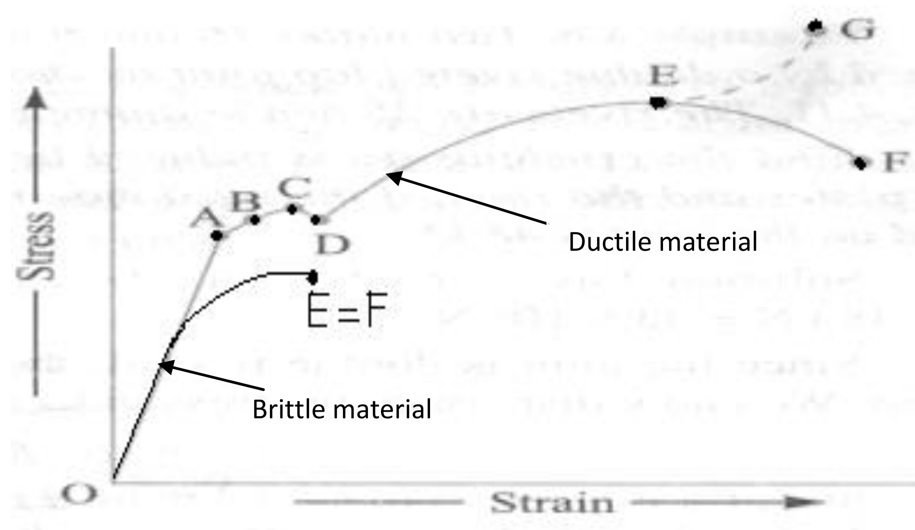
	condition viz. n = 2 j – 3 where, n= no. of links and j= no. of joints Deficient frame: A frame is said to be deficient if the number of members in it is less than that required for a perfect frame. Such frames can't retain their shape when loaded. Redundant frame: A frame is said to be redundant if the number of members it is more than that required for a perfect frame. Such frame can be analyzed by making use of equations of equilibrium alone.	02 marks 02 marks.	
2.	Attempt any Four of the following:		4X4=16
a	Ductility. It is the property of a material enabling it to be drawn into wire with the application of a tensile force. Toughness, It is the property of a material to' resist fracture due to high impact loads like hammer blows.		
b	It is defined, in general, as the ratio of the maximum stress to the working stress. Mathematically, Factor of safety = Maximum stress/Working or design stress In case of ductile material e.g. mild steel, where the yield point is clearly defined, the factor of safety in based upon the yield point stress. In this case, Factor of safety =Yield point stress/Working or design stress In case of brittle material e.g. cast iron, the yield point is not well defined as for ductile materials. Therefore, the factor of safety for brittle materials is based on ultimate stress Factor of safety=Ultimate stress/ Working or design stress This relation may be used for ductile materials. The following things are considered for the selection of Factor of Safety. i) The type of product. (i.e. whether it is a utility good or machine part etc.) ii) The importance/ position of the component in the assembly. iii) The extent of damage to the people and/or to other parts that may take place due to the failure of the part. iv) The cost of the material.	01 mark 01 mark 02 marks	04 marks
c	•Keyway is a slot machined either on the shaft or in the hub to accommodate the key. • It is cut by vertical or horizontal milling cutter. • The keyway cut into the shaft reduces the load carrying capacity of shaft. • This is due to stress concentration near the comers of the keyway and reduction in the crosssectionalarea of shaft. • In other words, the torsional strength of shaft is reduced. • The following relation of reduction factor is used to analyze the weakening effect of keyway is given by H. F. Moore. e = 1 - 0.2 (w/d) - 1.1(h/d) Where, e = shaft strength factor = Strength of shaft with keyway/Strength	01 mark 01 mark 01 mark 01 mark	04 marks

	Of shaft WIithout keyway w = Width of keyway, d = Diameter of shaft h = Depth of keyway = 112 x thickness of key = 1/2 x t • It is usually assumed that strength of keyed shaft is 75% of solid shaft. • Thus, after finding out dimensions of key, the reduction factor 'e' is calculated and for safe design, its value should be less than 0.75.		
d	Following are the advantages and disadvantages of welded joints over other method joints. Advantages 1. The welded structures are usually lighter than riveted structures. This is due to the reason that in welding, gussets or other connecting components are not used. 2. The welded joints provide maximum efficiency (may be 100%) which is not possible in case of riveted joints. 3. Alterations and additions can be easily made in the existing structures 4. As the welded structure is smooth in appearance, therefore it looks pleasing. 5. In welded connections, the tension members are not weakened as in the case of riveted joints. 6. A welded joint has a great strength. Often a welded joint has the strength of the parent metal itself. 7. Sometimes, the members are of such a shape (i.e. circular steel pipe) that they afford difficulty for riveting. But they can be easily welded. 8. The welding provides very rigid joints. This is in line with the modern trend of providing rigid frames. 9. It is possible to weld any part of a structure at any point. But riveting requires enough clearance. 10. The process of welding takes less time than the riveting. Disadvantages 1.Since there is an uneven heating and cooling during fabrication, therefore the member may get distorted or additional stresses may develop. 2. It requires a highly skilled labour and supervision. 3. Since no provision is kept for expansion and contraction in the frame, therefore there is a possibility of cracks developing in it. 4. The inspection of welding work is more difficult than riveting work.	02 marks (any 2 adv.) 02 marks (any 2 disadv.)	4m

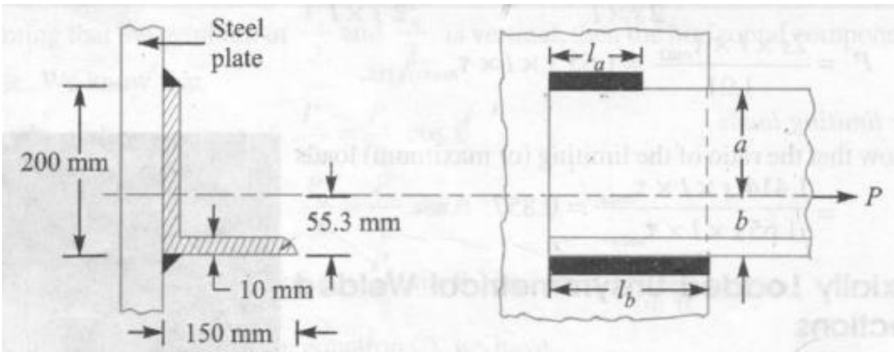
e	 Important Terms Used in Riveted Joints The following terms in connection with the riveted joints are important from the subject of view : (i)Pitch. It is the distance from the centre of one rivet to the centre of the next rivet measured parallel to the seam as shown in Fig. It is usually denoted by p. (ii)Back pitch. It is the perpendicular distance between the centre lines of the successive rows as shown in Fig. It is usually denoted by Pb. (iii)Diagonal pitch. It is the distance between the centres of the rivets in adjacent rows of zig-zagriveted joint as shown in Fig. It is usually denoted by Pd. (iv)Margin or marginal pitch. It is the distance between the centre of rivet hole to the nearest edge of the plate as shown in Fig. It is usually denoted by m.	02 marks for figure 02 marks for 04 terms	04 marks
f	Perfect frame : A pin-jointed frame which has got just sufficient number of members to resist the loads without undergoing appreciable deformation in shape is called rigid or perfect frame. The perfect frame obeys the following condition viz. $n = 2j - 3$ where, n= no. of links and j= no. of joints Deficient frame: A frame is said to be deficient if the number of members in it is less than that required for a perfect frame. Such frames can't retain their shape when loaded.	01 mark 01 mark 01 mark	

	Redundant frame: A frame is said to be redundant if the number of members it is more than that required for a perfect frame. Such frame can be analyzed by making use of equations of equilibrium alone.	01 mark	04
3.	Attempt any TWO of the following:		2X8=16
a	Given: d = 50 mm; τ = 42 MPa = 42 N/mm^2 σ_c = 70 MPa = 70 N/mm^2 The rectangular key is designed as discussed below: we find that for a shaft of 50 mm diameter, Width of key, w = 16 mm Ans. And thickness of key, t = 10 mm Ans. The length of key is obtained by considering the key in shearing and crushing. Let l = Length of key. Considering shearing of the key. We know that shearing strength (or torque transmitted)of the key, T = l x w X τ X d/2 = l x 16 x 42 x 50/2 = 16 800 l N-mm ……(i) and torsional shearing strength (or torque transmitted) of the shaft, T = π/16 x τ 'x d^3 = π/16 x 42 (50)^3 = = 1.03 X 106 N-mm …..(ii) From equations (i) and (ii), we have l = 1.03 x 106/16800 = 61.31 mm Now considering crushing of the key. We know that shearing strength (or torque transmitted the key, T = l x t/2x σ_c x d/2 = l x 10/2 x 70 x 50/2 = 8750 l N-mm From equations (ii) and (iii) , we have l = 1.03 X 106/8750 = 117.7 mm Taking larger of the two values, we have length of key, l = 117.7 say 120 ans.	01 mark 01 mark 01 mark 01 mark	04
b	Solution.  Given : Width = 75 mm; Thickness = 12.5 mm ; σt= 70 MPa = 70 N/rnrn^2 ; :τ= 56 MPa = 56 N/mm^2 The effective length of weld (ll) for the transverse weld may be obtained by subtracting 12.5 mm from the width of the plate. l1 = 75 - 12.5 = 62.5 mm Length of each parallel fillet for static loading Let l2 = Length of each parallel fillet. We know that the maximum load which the plate can carry is P = Area x Stress = 75 x 12.5 x 70 = 65 625 N		

	Load carried by single transverse weld, P1 = 0.707 s x l1 X σt = 0.707 x 12.5 x 62.5 x 70 = 38 664 N and the load carried by double parallel fillet weld, P2 = 1.414 s x l2 X τ: = 1.414 x 12.5 x l2 x 56 = 990 l2 N Load carried by the joint (P), 65 625 = P 1 + P 2 = 38 664 + 990 l2 or l2 = 27.2 mm Adding 12.5 mm for starting and stopping of weld run, we have l2= 27.2 + 12.5 = 39.7 say 40 mm Ans. Length of each parallel fillet for fatigue loading the stress concentration factor for transverse welds is 1.5 and for parallel fillet welds is 2.7. :. Permissible tensile stress, σt = 70/1.5 = 46.7 N/mm^2 and permissible shear stress, τ = 56 / 2.7 = 20.74 N/mm^2 Load carried by single transverse weld, P, = 0.707 s x l1X σt = 0.707 x 12.5 x 62.5 x 46.7 = 25 795 N and load carried by double parallel fillet weld, P2 = 1.414 s x l2 X τ = 1.414 X 12.512 x 20.74 = 366 l2.N :. Load carried by the joint (P), 65625 = PI + P2 = 25795 + 366 l2 or l2= 108.8 mm Adding 12.5 mm for starting and stopping of weld run, we have l2 = 108.8 + 12.5 = 121.3 mm Ans.		
c	Given: D = 350 mm.; p = 1.25 N/mm^2; σt = 33 MPa = 33 N/mm^2 Let d = Nominal diameter of studs, dc = Core diameter of studs, and n = Number of studs. We know that the upward force acting on the cylinder cover, P = π/4 x D^2 x P =. π/4 (350)^2 1.25 = 120265 N ...(i) Assume that the studs of nominal diameter 24 mm are used. From Table (coarse series), we find that the corresponding core diameter (de) of the stud is 20.32 mm. Resisting force offered by n number of studs, P = π/4 x (dc)^2 σt x n =. π/4 (20.32)^2 33 x n = 10700 n N ...(ii) From equations (i) and (ii), we get n = 120265/10 700 = 11.24 say 12 Ans Taking the diameter of the stud hole (d1) as 25 mm, we have pitch circle diameter of the studs, Dp = D + 2t + 3d1 = 350 + 2 x 10 + 3 x 25 = 445 mm ...(Assuming t = 10 mm) Circumferential pitch of the studs = (π x Dp) / n = (π x 445) / 12 = 116.5 mm We know that for a leak-proof joint, the circumferential pitch of the studs should be between 20√d; to 30√d; , where d1is the diameter of stud hole in mm. :. Minimum circumferential pitch of the studs)		

	$=20\sqrt{d}$; $= 20\sqrt{25} = 100$ mm and maximum circumferential pitch of the studs $=30\sqrt{d}$; $= 30\sqrt{25} = 150$ mm Since the circumferential pitch of the studs obtained above lies within 100 mm to 150 mm, therefore the size of the stud chosen is satisfactory. Size of the stud = M 24 Ans		
4.	Attempt any TWO of the following:		2X8=16
a	Given: N = 200 r.p.m. ; $P = 20$ kW $= 20 \times 10^3$ W; $\tau = 42$ MPa $= 42$ N/mm^2 Let d = Diameter of the shaft. We know that torque transmitted by the shaft, $T = (p \times 60) / (2\pi N)$ We also know that torque transmitted by the shaft (T), $955 \times 10^3 = \pi /16 \times \tau x d^3 = \pi /16 \times 42 x d^3$ $d^3 = 955 \times 10^3/8.25 = 115\,733$ or d = 48.7 say 50 mm Ans		
b i	 A. Proportional limit: Hooke's law holds good up to point A and it is known as proportional limit. It is defined as that stress at which the stress-strain curve begins to deviate from the straight B. Elastic limit: The material has elastic properties up to the point B. This point is known as elastic limit. It is defined as the stress developed in the material without any permanent set C & D. Yeild Point: There are two yield points C and D. The points C and D are called the upper and lower yield points respectively. E. Ultimate stress: At E, the stress, which attains its maximum value is known as ultimate stress. F. Breaking strength: Failure is complete	4m	4m
b ii	Shaft couplings are used in machinery for several purposes, the most		

	common of which are the following: 1. To provide for the connection of shafts of units that are manufactured separately such as a motor and generator and to provide for disconnection for repairs or alternations. 2. To provide for misalignment of the shafts or to introduce mechanical flexibility. 3. To reduce the transmission of shock loads from one shaft to another. 4. To introduce protection against overloads. S. It should have no projecting parts		
c	Given: Q = 2400 m^3/h = 40 m^3/min; p = 1.4 N/mm^2; v = 30 mls = 1800 m/min бt = 40MPa = 40 N/mm^2 Inside diameter of the pipe We know that inside diameter of the pipe, D=1.13 $\sqrt{(Q/v)}$ = 1.13 $\sqrt{(40/1800)}$ = 0.17 = 170mm Wall thickness of the pipe Assuming C=3 for a steel pipe, wall thickness of the pipe T ={(p.D) /(2бt)} + C ={(1.4 x 170) /(2 x 40)} + 3 = 6 mm	02 marks 02 marks	04 marks

5.	Attempt any TWO of the following:		2X8=16
a	Solution.  Given: a + b = 200 mm ; P = 200 kN = 200 X 10^3 N ; τ = 75 MPa = 75 N/rnm^2 Let la = Length of weld at the top, lb = Length of weld at the bottom, and l = Total length of the weld = la+ lb Since the thickness of the angle is 10 mm, therefore size of weld, x = 10mm We know that for a single parallel fillet weld, the maximum load (P), 200 X 103 = 0.707 s x I x 't = 0.707 x 10 x I x 75 = 530.~ l= 200 X 10^3/530.25 = 377 mm la + Ib = 377 mm Now let us find out the position of the centroidal axis. Let b = Distance of centroidal axis from the bottom of the angle. and b=[(200 - 10) 10 x 95 + 150 x 10 x 5]/[190 x 10 + 150 x 10] b = 55.3 mm a = 200 - 55.3 = 144.7 mm Ia = I x b / a + b = 377 x 55.3 /200= 104.2 mm Ans. lb = I-la = 377 - 104.2 = 272.8 mm Ans		
b i	Stress concentration can be defined as the increase in the iintensity of stress due to various factors such as abrupt change in cross section, sharp corners,presence of holes, internal deformities, cracks,etc. The presence of stress concentration cannot be totally eliminated but it may be reduced to some extent. A device or concept that is useful in assisting a design engineer to visualize the presence of stress concentration and how it may be reduced is that of stress flow lines, as shown in Fig. The reduction of stress concentration means that the stress flow lines shall maintain their spacing as far as possible.	02 marks 02	4m

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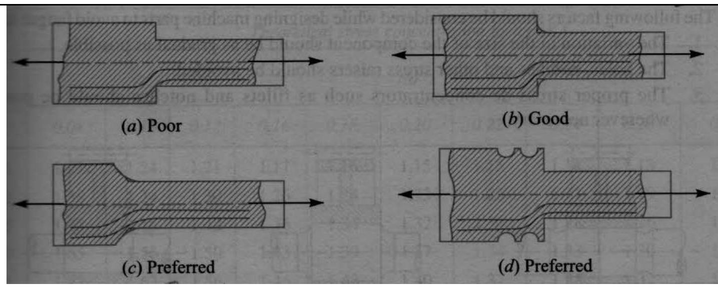
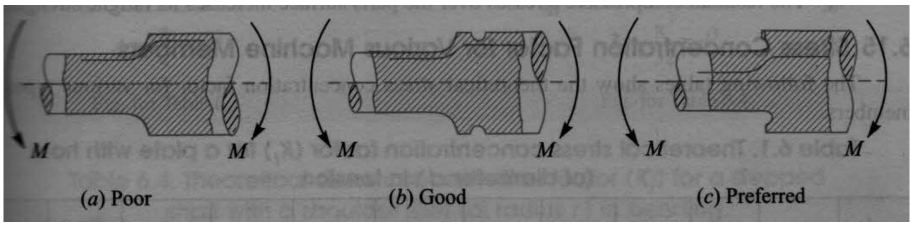
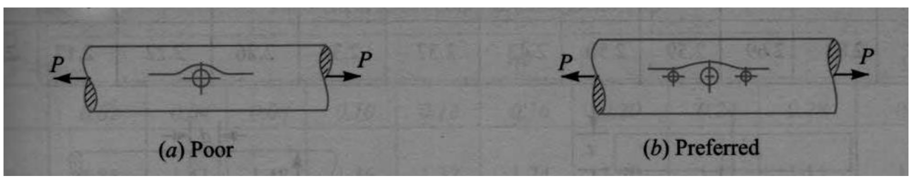
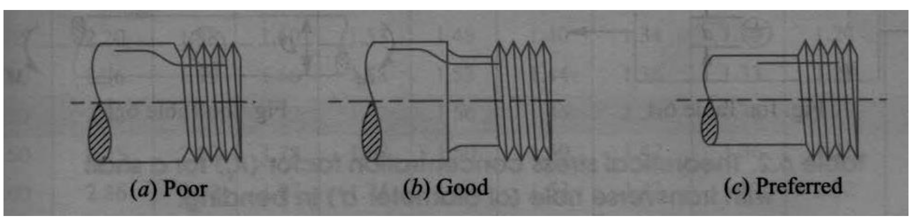




Method of reducing stress contraction in cylinder members with shoulders



Method of reducing stress contraction in cylinder members with holes



Method of reducing stress contraction in cylinder members with holes

The stress concentration effects of a press fit may be reduced by making more gradual transition from the rigid to the more flexible shaft. The various ways of reducing stress concentration for such cases are shown in Fig. a,b,c
</td>
<td>marks (any 2)</td>
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<tr>
<td>b ii</td>
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<td>c i</td>
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Procedure for method Joint:

1) For a simply supported frame consider the FBD of entire frame applying condition of equilibrium find support reaction.
2) Consider the FBD of joint from the trusses at which not more than two members with unknown force exist.
3) Assume the member to be in tensile or compression by simple inspection and applying condition of equilbrium.Find answer.
4) The Assumed sense can be verified from the obtained numerical results. A positive answer indicates that the fence is correct whereas negative answer indicates that the sense shown on the FBD must be changed.
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<td>04 mark for any four points.</td>
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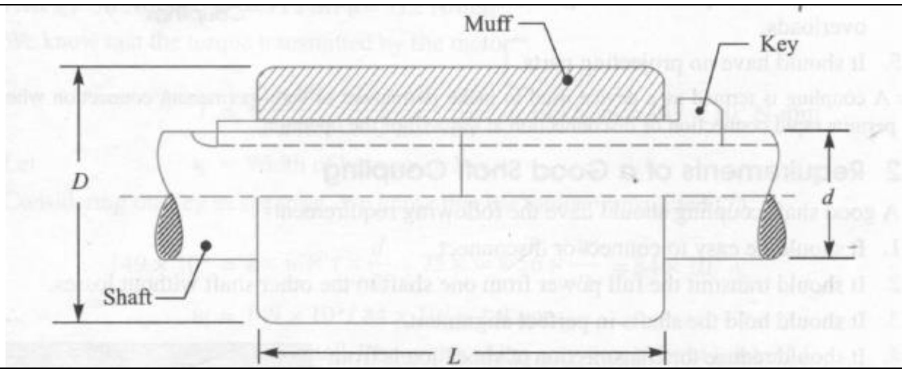
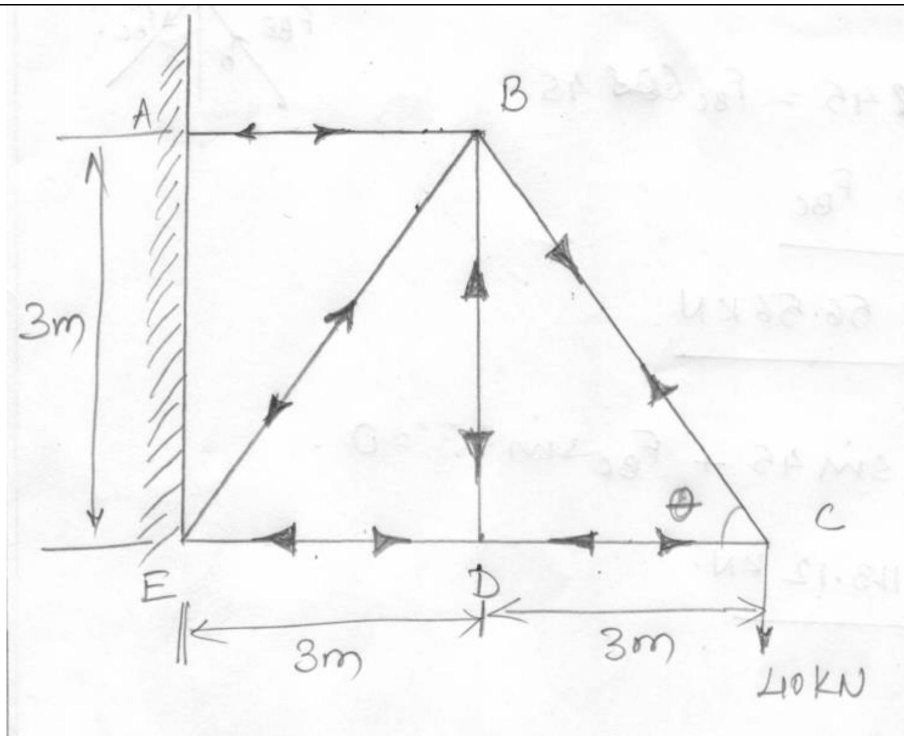
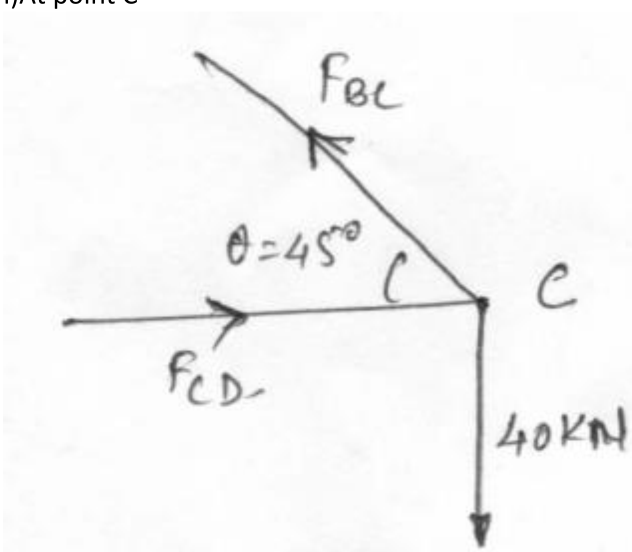
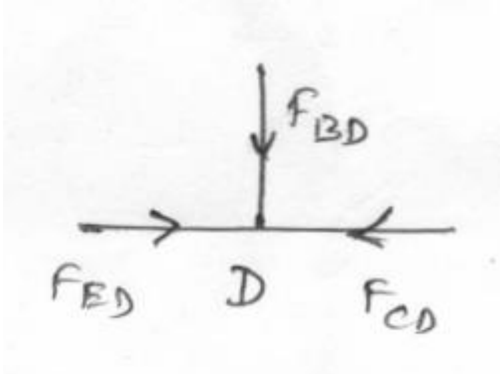
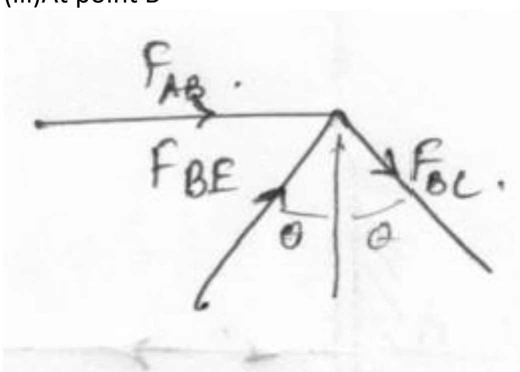
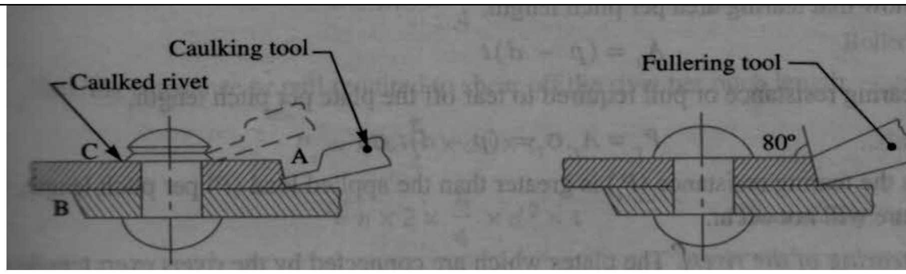
	5) Select the new FBD of joint with not more than two unknown in members and respect the point 3,4and 5 for complete analysis. 6) Tabulate the answer representing member magnitude of force and their nature.		04 marks
c ii			
6.	Attempt any FOUR of the following:		4X4=16
a i	Solution. Given: t = 10 mm ; σt= 80 MPa = 80 N/mm^2 ; τ= 60 MPa = 60 N/mm^2 1. Diameter of rivet Since the thickness of plate is greater than 8 mm, therefore diameter of rivet hole, $d = 6\sqrt{t} = 6\sqrt{10} = 18.97$ mm , we see that according to IS : 1928 - 1961 (Reaffirmed 1996), the standard diameter of rivet hole (d) is 19 mm and the corresponding diameter of the rivet is 18 mm. Ans. 2. Pitch of rivets Let p = Pitch of rivets. Since the joint is a single riveted double strap butt joint therefore there is one rivet per pitch length (i.e. n = 1) and the rivets are in double shear. - We know that tearing resistance of the plate, P1 = (p-d)tx σt =(p-19)10x80=800(p-19)N ...(i) and shearing resistance of the rivets, pa n x 1.875 x π /4xd^2 x τ ....(Rivets are in double shear) = 1 x 1.875 x π /4 (19)^{2}60 = 31900 N ...(.: n = 1) ...(ii) From equations (i) and (ii), we get 800 (p - 19) = 31 900 .. p - 19 = 31 900/800 = 39.87 or p = 39.87 + 19 = 58.87 say 60 mm According to I.B.R., the maximum pitch of rivets, Pmax = C.t + 41.28 mm we find that for double strap butt joint and 1 rivet per pitch length, the value of C is 1.75. Pmax = 1.75 x 10 + 41.28 = 58.78 say 60 mm From above we see that p =Pmax = 60 mm Ans.		

	3. Thickness of cover plates We know that thickness of cover plates, $t1 = 0.625\ t = 0.625 \times 10 = 6.25$ mm Ans. Efficiency of the joint We know that tearing resi tance of the plate, $Pt= (p - d)\ t \times \sigma t = (60 - 19)\ 10 \times 80 = 32\ 800$ N and shearing resistance of the rivets, $Ps = n \times 1.875 \times \pi /4 \quad \times d^2 \times \tau = 1 \times 1.875 \times \pi /4 \quad \times 19^2 \times 60 = 31900$N Strength of the joint = Least of P, and Ps = 31900 N Strength of the unriveted plate per pitch length $P= p \times t \times \sigma t = 60 \times 10 \times 80 = 48\ 000$ N Efficiency of the joint, η =Least of Pt and Ps /P = 31 900/48000= 0.665 or 66.5% Ans.		
a ii	Following are the advantages and disadvantages of the screwed joints. Advantages 1. Screwed joints are highly reliable in operation. 2. Screwed joints are convenient to assemble and disassemble. 3. A wide range of screwed joints may be adopted to various operating conditions. 4. Screws are relatively cheap to produce due to standardisation and highly efficient manufacturing processes. Disadvantages The main disadvantage of the screwed joints is the stress concentration in the threaded portions which are vulnerable points under variable load conditions. Note: The strength of the screwedjoints is not comparable with that of riveted or welded joints		

b i	 i)At point C  FCD = FBC (Cos θ)…………..(i) FBC Sin45^0=40 FBC= 40/ Sin45^0 =56.56KN FCD=40KN (ii)At point D		

	 FED= FCD FED=40KN FBD=0 (iii)At point B  $FBECos45^0=FBCCos45^0$ FBE=FBC FBE=56.56KN $FAB + FBESin45^0+FBCSIN45^0=0$ FAB=-113.12KN		
b ii	In order to make the joints leak proof or fluid tight in pressure vessels like steam boilers, air receivers and tanks etc. a process known as **caulking** is employed. In this process, a narrow bunt tool called caulking tool about 5 mm thick and 38 mm in breadth is used. The edge of the tool is ground to an angle of 80°. The tool is moved after each blow along the edge of the plate, which is planned to a bevel of 75° to 80° to facilitate the forcing down of edge. A more satisfactory way of making the joints staunch is known as **fullering** which has largely superseded caulking. In this case, a fullering tool with a thickness at the end equal to that of the plate is used in such a way that the greatest pressure due to the blows occur near the joint, giving a clean finish, with less risk of damaging the plate.	02 marks 02 marks	04

	 Caulking Fullering		