Scoring Indicators

COURSE NAME : Design of Machine Elements

COURSE CODE : 5021 **QID : 2109230031 (A)**

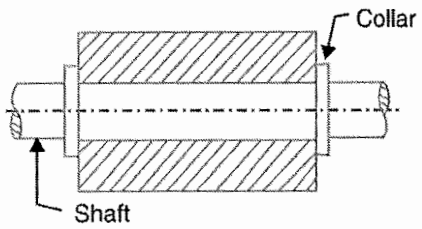
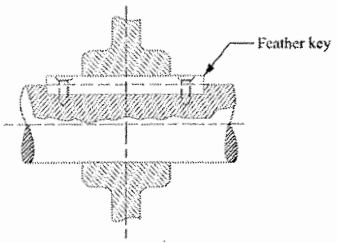
PART A

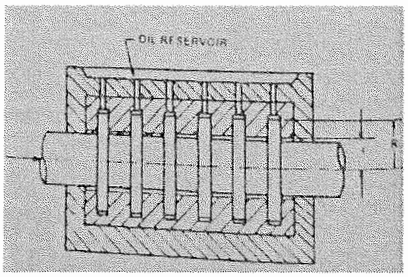
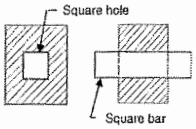
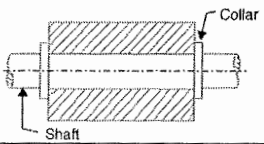
I. Answer all the following questions in one word or sentence.

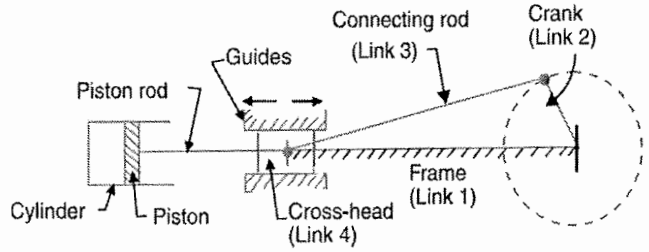
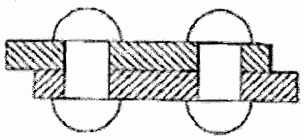
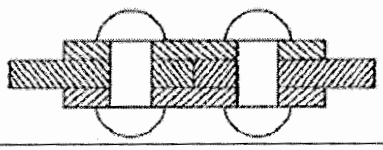
(9 x 1 = 9 Marks)

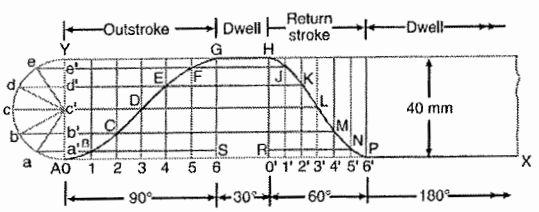
Max. marks

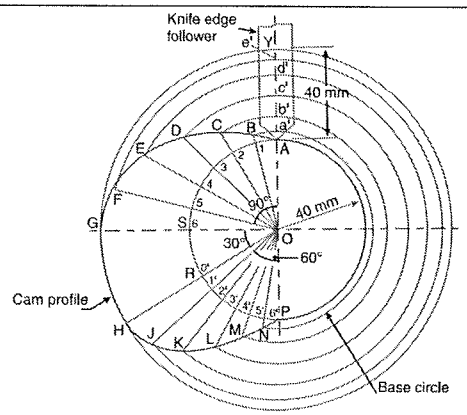
Q.No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			24
I.1	Strength, cost, shape, size, safety, weight (any two)	0.5 × 2	1	
I.2	Each part of a machine, which moves relative to some other part, is known as a kinematic link (or simply link) or element. A link may consist of several parts, which are rigidly fastened together, so that they do not move relative to one another. (any one sentence)	1	1	
I.3	Transmission shaft, machine shaft	0.5 × 2	1	
I.4	Woodruff key	1	1	
I.5	It is a reference point on the follower and is used to generate the pitch curve.	1	1	
I.6	Internal combustion engines, press work	0.5 × 2	1	
I.7	Sometimes, the frictional grip becomes insufficient in the belt and pulley, cause some forward motion of the belt without carrying the driven pulley with it. This is called slip of the belt and is generally expressed as a percentage.	1	1	
I.8	It is the surface of the gear tooth below the pitch surface.	1	1	
I.9	They give smooth, steady and quiet service. They are little affected by outdoor conditions. The shafts may be out of strict alignment. The power may be taken off in any direction and in fractional parts of the whole amount. They give high mechanical efficiency. (any two)	0.5 × 2	1	
	PART B			24
II.1	When the motion between a pair is limited to a definite direction irrespective of the direction of force applied, then the motion is said to be a completely constrained motion. Eg: piston and cylinder, shaft with both side	Explanation – 1 Figure -	3	

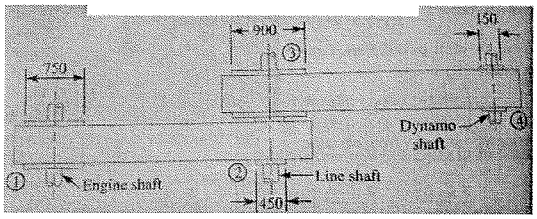
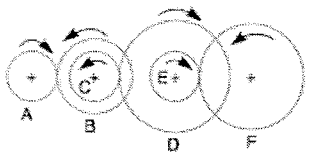
	collar's.  	2		
II.2	Standard Sizes: 25mm to 60mm with 5mm steps. 60mm to 110mm with 10mm steps. 110mm to 140mm with 15mm steps. 140mm to 500mm with 20mm steps. (any two) Standard length: 5m, 6m, 7m	2 1	3	
II.3	Power , P = (2πNT)/60 Where N = Speed of shaft in rpm T = torque transmitted	2 1	2	
II.4	For solid shaft, $J = \frac{\pi}{32} d^4$ For hollow shaft, $J = \frac{\pi}{32}(d_o{}^4 - d_i{}^4)$ Where, do – outer diameter of shaft di - internal diameter of shaft	1 1 1	3	
II.5	A key attached to one member of the connected torque transmitting members and which permits relative axial movement is known as feather key. It is a special type of parallel key which transmits a turning moment and also permits axial movement. It is fastened either to the shaft or hub.  	Explanation – 1 Figure - 2	3	
II.6	Wedge cam radial (disc) cam cylindrical cam	1 × 3	3	

II.7	Two types i.Centrifugal governors (further divided in to pendulum type, loaded type) ii.Inertia governors	2 1	3	
II.8	Rigid coupling(sleeve or muff type, flange type) Flexible coupling(bushed type, universal type)	2 1	3	
II.9	In this case a shaft passes through the bearings, bearing take up the axial loads, shaft having multiple collars. 	Explanation – 1 Figure - 2	3	
II.10	Based on friction - belt drives, rope drives Based on engagement - chain drives, gear drives	2 1	3	
	PART C			42
	Sliding pair. When the two elements of a pair are connected in such a way that one can only slide relative to the other, the pair is known as a sliding pair. The piston and cylinder, cross-head and guides of a reciprocating steam engine, ram and its guides in shaper, tail stock on the lathe bed etc. are the examples of a sliding pair. A little consideration will show, that a sliding pair has a completely constrained motion.  Turning pair. When the two elements of a pair are connected in such a way that one can only turn or revolve about a fixed axis of another link, the pair is known as turning pair. A shaft with collars at both ends fitted into a circular hole, the crankshaft in a journal bearing in an engine, lathe spindle supported in head stock, cycle wheels turning over their axles etc. are the examples of a turning pair. A turning pair also has a completely constrained motion. 	Explanation – 3 Figure – 4	7	

IV	**OR** Given: Width = 100 mm Thickness = 10 mm $P = 80\ KN = 80 \times 10^3\ N$ Let, L = length of weld S = size of weld= plate thickness = 10 mm $\tau = 55\ MPa = 55\ N/mm^2$ The maximum load which the plates can carry for double parallel fillet weld, $P = 1.414\ S \times l \times \tau$ $80 \times 10^3 = 1.414 \times 10 \times l \times 55$ $= 778\ l$ $l = 103$ mm Adding 12.5 mm for starting and stopping of weld run, $l = 103 + 12.5 = 115.5$ mm (Ans)	Data 1 Equn 2 2 2	7	
V	A single slider crank chain is a modification of the basic four bar chain. It consist of one sliding pair and three turning pairs. It is, usually, found in reciprocating steam engine mechanism. This type of mechanism converts rotary motion into reciprocating motion and vice versa. In a single slider crank chain, the links 1 and 2, links 2 and 3, and links 3 and 4 form three turning pairs while the links 4 and 1 form a sliding pair.  	Explanation – 3 Figure – 4	7	
VI	**OR** Double riveted lap joint Two rows of rivets are used for the connection.  Double riveted butt joint with double cover plate Two rows of rivets are used on each side of the joint 	Explanation – 3 Figure – 4	7	

	and hence in total there are four rows of rivets in double riveted joint.		
VII	Given: d=50 mm, τ=42 MPa = 42 N/mm^2 w=16 mm t= 10 mm Considering shearing of the key, T= l×w×τ×d/2 = 16800 l Nmm Equn. (1) Torque transmitted by the shaft, T= (π/16)×τ×d^3 Equn. (2) = 1.03 × 10^6 Nmm Equating 1 & 2, We have , l= 61.31 mm. **OR**	Data 1 2 1 1 1	7
VIII	Given: N=200 rpm, τ=42 MPa = 42 N/mm^2 P=20 KW = 20 ×10^3 W d= diameter of shaft Torque transmitted by the shaft, T= P×60/(2πN) = 955 ×10^3 Nmm Also, Torque transmitted by the shaft, T= (π/16)×τ×d^3 955 ×10^3 = 8.25 d^3 d= 48.7 mm = 50 mm	Data 1 2 1 1 1	7
IX		Displacement diagram -2 Cam profile – 5	7

8 X	 **OR** **Flywheel** / **Governor** 1. Reduce the cyclic variation of speed due to difference in input and output. / Maintain a constant speed of prime mover when the variation of speed occurs due to fluctuation of load. 2. Action is continuous from cycle to cycle. / Action is intermittent i.e. when load changes on engine. 3. Stores energy and gives up whenever required during the cycle. / Regulates input energy (i.e. working fluid) according to the load so as to maintain constant speed. 4. No control over the quality of working agent. / Changes the quality of the working agent. 5. Not an essential element of every prime mover. / Essential element of every prime mover.	7	7
X 1 9 10 X 11	The rope drives are widely used where a large amount of power is to be transmitted, from one pulley to another, over a considerable distance. It may be noted that the use of flat belts is limited for the transmission of moderate power from one pulley to another when the two pulleys are not more than 8 metres apart. If large amounts of power are to be transmitted by the flat belt, then it would result in excessive belt cross-section. The frictional grip in case of rope drives is more than that in V-drive. One of the main advantage of rope drives is that a number of separate drives may be taken from the one driving pulley. For example, in many spinning mills, the line shaft on each floor is driven by ropes passing directly from the main engine pulley on the ground floor. The rope drives use the following two types of ropes : 1. Fibre ropes, and 2. Wire ropes. **OR** Given: N_1= 150 rpm, d_1= 750 mm, d_2 = 450 mm, d_3= 900 mm , d_4 = 150 mm	5 2 Data 1	7 7

	N_4 = speed of the dynamo shaft  $N_4/ N_1 = (d_1 \times d_3) / (d_2 \times d_4)$ $= (750 \times 900) / (450 \times 150)$ N_4 = 1500 rpm.	1 2 2 1	
XIII 11	Advantages As no slip takes place during chain drive Perfect velocity ratio is obtained Since the chains are made of metal, therefore they occupy less space in width than a belt drive. The chain drives may be used when the distance between the shafts is less. The chain drive gives a high transmission efficiency (upto 98 per cent). The chain drive gives less load on the shafts. The chain drive has the ability of transmitting motion to several shafts by one chain only. (ANY FIVE) *Disadvantages* The production cost of chains is relatively high. The chain drive needs accurate mounting and careful maintenance. The chain drive has velocity fluctuations especially when unduly stretched. (ANY TWO)	1 × 5 1×2	7
	OR		
XIV 12	 Gear: A 20, B 50, C 25, D 75, E 26, F 65 N_F = speed of gear F(last driven follower) $(N_A/N_F) = (T_B \times T_D \times T_F)/ (T_A \times T_C \times T_E)$ $(N_A/N_F) = (50 \times 75 \times 65) / (20 \times 25 \times 26)$ N_F = 52 rpm	Data 1 3 2 1	7