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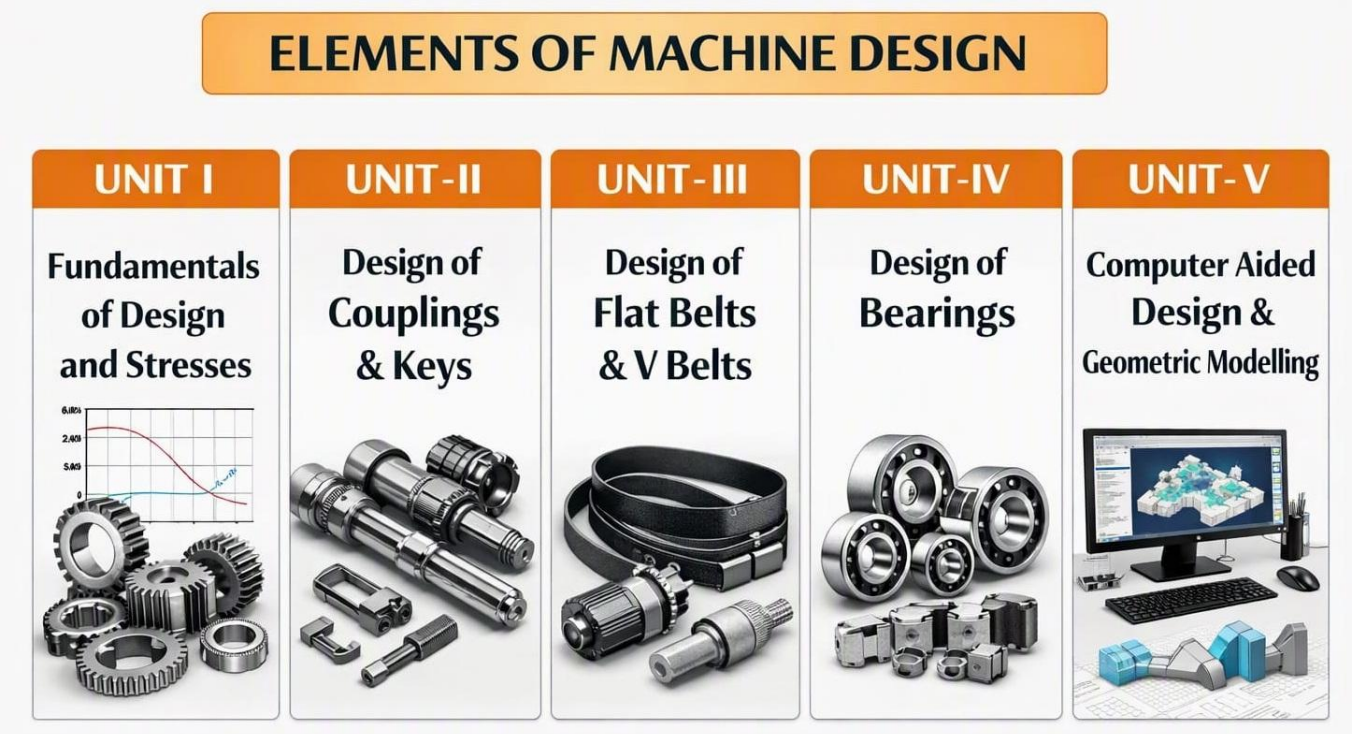
(An Autonomous Institution)

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK

EME51010 – ELEMENTS OF MACHINE DESIGN

(E – SCHEME)



1020235110 THEORY	ELEMENTS OF MACHINE DESIGN	L	T	P	C
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DETAILED SYLLABUS

Unit – I: FUNDAMENTALS OF DESIGN AND STRESSES	
Introduction about component design - engineering materials - factors affecting selection of materials - BIS designation of ferrous materials - preferred number - factor of safety and allowable stress - stresses: tension, compression, shear, bearing pressure intensity, crushing, bending and torsion - problems. Composite material - types, property and applications. Creep strain and creep curve - Fatigue, S-N curve, endurance limit - stress concentration. Theories of elastic failures - principal normal stress theory, maximum shear stress theory and maximum distortion energy theory.	9
Unit – II: DESIGN OF COUPLINGS AND KEYS	
Couplings - Requirements of good couplings - types - design of rigid protected type flange couplings - marine coupling - pin type flexible couplings (description only). ***Keys*** - Types of keys - Design of sunk keys only - Effect of keyways on shaft - problems.	9
Unit – III: DESIGN OF FLAT BELTS AND V-BELTS	
Flat Belts: Types of belts - materials for belt - types of belt drives - speed ratio - effect of slip - length of flat belts - tension ratio - centrifugal tension - power transmitted - condition for maximum power transmission - initial tension - design procedure of flat belts - design of flat belt based on manufacturer's data only - problems. ***V-belt drive:*** Comparison with flat belt drive - designation of V belts - length of belt - power transmitted - design of V-belt using manufacturer's data only - problems.	9
Unit – IV: DESIGN OF BEARINGS	
Bearings: Classifications of bearings - sliding contact and rolling contact bearings - radial and thrust bearings - roller bearing - types - designation of ball bearings - materials used for bearings - journal bearings - heat generated, heat dissipated, cooling oil requirement - problems - design of journal bearings - problems - design based on approved data book only. (No problem from dimensionless parameters).	9

UNIT	Q NO	QUESTIONS
1	1	What is the main objective of component design in engineering? (A) To manufacture all components in a similar way (B) To ensure the component fits, functions, and lasts under load (C) To reduce weight regardless of performance (D) To use expensive materials only **Ans:B) To ensure the component fits, functions, and lasts under load**
1	2	Which of the following is a property of engineering materials? (A) Color only (B) Melting without change (C) Mechanical strength (D) All of the above **Ans:C) Mechanical strength**
1	3	BIS stands for: (A) Bureau of Indian Standards (B) Bureau of International Standards (C) British International Standard (D) Bureau of Iron and Steel **Ans:A) Bureau of Indian Standards**
1	4	Which of the following is a non-ferrous material? (A) Cast iron (B) Mild steel (C) Copper (D) Wrought iron **Ans:C) Copper**
1	5	Non-ferrous materials do NOT contain: (A) Zinc (B) Aluminum (C) Iron (D) Copper **Ans:C) Iron**
1	6	Which of the following is a key factor in selecting materials for a machine component? (A) The designer's favorite color (B) The availability and cost of the material (C) The brand name of the material (D) The weight of the material only **Ans:B) The availability and cost of the material**
1	7	Which of the following factors affects the selection of materials in design? (A) Cost (B) Availability (C) Mechanical properties (D) All of the above **Ans:D) All of the above**
1	8	Preferred numbers in engineering design are used to: (A) Make random selections (B) Follow standard series of sizes (C) Choose maximum numbers (D) Ignore standardization **Ans:B) Follow standard series of sizes**

UNIT	Q NO	QUESTIONS
1	9	The factor of safety (FoS) for ductile materials is the ratio of: (A) Working stress to ultimate stress (B) Yield stress to working stress (C) Ultimate stress to yield stress (D) Allowable stress to yield stress **Ans:B) Yield stress to working stress**
1	10	Factor of safety is used to: (A) Increase cost (B) Improve speed (C) Prevent failure (D) Improve appearance **Ans:C) Prevent failure**
1	11	Factor of safety is always: (A) Less than 1 (B) Equal to 1 (C) Greater than 1 (D) Zero **Ans:C) Greater than 1**
1	12	What is allowable stress? (A) The maximum stress a material can withstand (B) The minimum stress required for failure (C) The maximum stress that is considered safe for a design (D) The same as ultimate stress **Ans:C) The maximum stress that is considered safe for a design**
1	13	If the yield stress is 400 MPa and factor of safety is 2, what is the allowable stress? (A) 100 MPa (B) 800 MPa (C) 200 MPa (D) 600 MPa **Ans:C) 200 MPa**
1	14	Tensile stress is caused by a load that tends to_____ the body. (A) Compress (B) Bend (C) Elongate (D) Twist **Ans:C) Elongate**
1	15	A force that pushes a material is known as: (A) Compression (B) Shear (C) Tension (D) Torsion **Ans:A) Compression**
1	16	Shear stress acts: (A) Along the length of the material (B) At a right angle to the surface (C) Tangentially to the surface (D) Does not act on solids **Ans:C) Tangentially to the surface**

UNIT	Q NO	QUESTIONS
1	17	The stress that acts on a surface due to a bearing load is called: (A) Bending stress (B) Torsional stress (C) Bearing pressure intensity (D) Shear stress **Ans:C) Bearing pressure intensity**
1	18	Crushing failure occurs due to: (A) Excessive bending (B) Tension over the limit (C) Excessive compressive force on a small area (D) Fatigue load **Ans:C) Excessive compressive force on a small area**
1	19	In pure bending, the section subjected to maximum stress is: (A) Neutral axis (B) Top fiber (C) Bottom fiber (D) Outer most fiber **Ans:D) Outer most fiber**
1	20	Torsional stress is induced by a _____ moment. (A) Bending (B) Twisting (C) Compressing (D) Pulling **Ans:B) Twisting**
1	21	Torsion in a circular shaft produces: (A) Shear stress (B) Normal stress (C) Bending stress (D) Crushing stress **Ans:A) Shear stress**
1	22	Composite materials are: (A) Homogeneous (B) Made of two or more constituent materials (C) Used only in automotive industry (D) Single-phase materials **Ans:B) Made of two or more constituent materials**
1	23	An example of fiber-reinforced composite is: (A) Steel (B) Concrete (C) Carbon fiber epoxy (D) Brass **Ans:C) Carbon fiber epoxy**
1	24	Composite materials are mainly used for: (A) Increasing weight (B) Reducing strength (C) Enhancing properties of base materials (D) Corrosion **Ans:C) Enhancing properties of base materials**

UNIT	Q NO	QUESTIONS
1	25	The application of composite materials is often found in: (A) Heavy construction (B) Aerospace industry (C) Household utensils (D) Low-tech applications **Ans:B) Aerospace industry**
1	26	Creep occurs under: (A) Rapid loading (B) High impact loading (C) Constant load for a long time at high temperature (D) Low temperature **Ans:C) Constant load for a long time at high temperature**
1	27	The three stages of a typical creep curve are: (A) Primary, Secondary, Tertiary (B) Initial, Peak, Decline (C) Elastic, Plastic, Fracture (D) Loading, Unloading, Failure **Ans:A) Primary, Secondary, Tertiary**
1	28	The third stage of the creep curve is: (A) Recovery (B) Constant strain rate (C) Primary deformation (D) Accelerated deformation **Ans:D) Accelerated deformation**
1	29	The S-N curve is used to determine the _____ of a material. (A) Ultimate strength (B) Yield strength (C) Endurance limit (D) Hardness **Ans:C) Endurance limit**
1	30	In an S-N curve, 'N' stands for: (A) Nominal stress (B) Number of cycles to failure (C) Newton (D) Neutral axis **Ans:B) Number of cycles to failure**
1	31	What is 'fatigue' in materials? (A) The failure of a material under static load (B) The weakening of a material caused by repeatedly applied loads (C) The deformation of a material due to high temperature (D) The corrosion of a material **Ans:B) The weakening of a material caused by repeatedly applied loads**
1	32	Fatigue failure is caused by: (A) Static loads (B) Impact loads (C) Repeated or fluctuating loads (D) High temperature **Ans:C) Repeated or fluctuating loads**

UNIT	Q NO	QUESTIONS
1	33	Endurance limit is the: (A) Maximum load before rupture (B) Minimum load to cause yielding (C) Stress below which fatigue failure will not occur (D) Load to cause permanent deformation **Ans:C) Stress below which fatigue failure will not occur**
1	34	Stress concentration occurs due to: (A) Uniform geometry (B) Smooth surfaces (C) Notches, holes, or sharp changes in cross-section (D) Uniform material **Ans:C) Notches, holes, or sharp changes in cross-section**
1	35	Which of the following causes stress concentration? (A) Uniform cross-section (B) Sudden changes in cross-section (C) Smooth surface (D) Constant temperature **Ans:B) Sudden changes in cross-section**
1	36	Which method is not used to reduce stress concentration? (A) Adding notches (B) Fillet radius (C) Material grading (D) Providing relief grooves **Ans:A) Adding notches**
1	37	The principal stress theory assumes failure when: (A) Shear strain exceeds critical value (B) Maximum normal stress exceeds ultimate stress (C) Distortion energy reaches a limit (D) All stresses become equal **Ans:B) Maximum normal stress exceeds ultimate stress**
1	38	Theories of failure are used to predict: (A) The color change of a material (B) The yielding or fracture of a material under combined stresses (C) The cost of a component (D) The manufacturing process **Ans:B) The yielding or fracture of a material under combined stresses**
1	39	Principal normal stress theory is also called: (A) Guest theory (B) Rankine theory (C) Tresca theory (D) Von Mises theory **Ans:B) Rankine theory**
1	40	Stress concentration factor (Kt) is the ratio of: (A) Mean stress to alternating stress (B) Nominal stress to maximum stress (C) Maximum stress to nominal stress (D) Strain to stress **Ans:C) Maximum stress to nominal stress**

UNIT	Q NO	QUESTIONS
1	41	What is the unit of stress? (A) N (B) N-m (C) N/m² (Pascals) (D) m/s² **Ans:C) N/m² (Pascals)**
1	42	Mild steel is also known as: (A) Tool steel (B) Low carbon steel (C) Alloy steel (D) White iron **Ans:B) Low carbon steel**
1	43	Which steel is best suited for gears and heavy-duty shafts? (A) Cast iron (B) Stainless steel (C) High-carbon steel (D) Alloy steel (e.g. 40Cr1Mo28) **Ans:D) Alloy steel**
1	44	1 MPa is equal to how many N/mm²? (A) 0.1 N/mm² (B) 1 N/mm² (C) 10 N/mm² (D) 100 N/mm² **Ans:B) 1 N/mm²**
1	45	Stainless steel contains: (A) Carbon and lead (B) Copper and iron (C) Iron and chromium (D) Zinc and copper **Ans:C) Iron and chromium**
1	46	Ductility is the property by which a material can undergo large _____ deformation. (A) Elastic (B) Plastic (C) Brittle (D) Thermal **Ans:B) Plastic**
1	47	In the BIS system, 50C4 means: (A) 0.50% Carbon, 0.4% Chromium (B) 0.5% Carbon, 0.4% Manganese (C) 0.5% Carbon, 0.4% Carbon (D) Carbon and 4% Nickel **Ans:B) 0.5% Carbon, 0.4% Manganese**
1	48	Which component is most likely to suffer from stress concentration? (A) Smooth bar (B) Threaded rod (C) Uniform beam (D) Homogeneous plate **Ans:B) Threaded rod**

UNIT	Q NO	QUESTIONS
1	49	Which of the following does not typically cause stress concentration? (A) Keyways (B) Fillets (C) Holes (D) Notches **Ans:B) Fillets**
1	50	Match the correct mechanical properties from the following: Match the correct mechanical properties from the following: 1. Ductility a) Resist abrasion and scratch 2. Malleability b) Drawn into thin wire 3. Hardness c) Resisting the elastic and plastic deformation 4. Toughness d) Hammered into thin sheet (A) 1-b, 2-d, 3-a, 4-c (B) 1-a, 2-d, 3-b, 4-c (C) 1-b, 2-c, 3-a, 4-d (D) 1-d, 2-b, 3-a, 4-c **Ans:A) 1-b, 2-d, 3-a, 4-c**
2	51	What is the primary function of a coupling? (A) To connect two shafts and transmit power (B) To increase the speed of a shaft (C) To support a rotating shaft (D) To act as a brake **Ans:A) To connect two shafts and transmit power**
2	52	Which of the following is not a requirement of a good coupling? (A) Easy to assemble (B) Transmit torque (C) Frequent lubrication (D) Accommodate misalignment **Ans:C) Frequent lubrication**
2	53	A rigid coupling is used to connect shafts that are: (A) Perfectly aligned (B) At an angle (C) Parallel but not aligned (D) Intersecting **Ans:A) Perfectly aligned**
2	54	Flange coupling bolts are subjected to: (A) Shear (B) Bending (C) Torsion (D) Axial compression **Ans:A) Shear**
2	55	In a protected type flange coupling, the flange has a shroud to: (a) Increase the weight (b) Cover the bolt heads and nuts for safety (c) Improve appearance (d) Reduce the transmitted torque **Ans:Answer: b) Cover the bolt heads and nuts for safety**
2	56	Which of the following is not a type of flexible coupling? (a) Jaw coupling (b) Pin bush coupling (c) Flange coupling (d) Universal coupling **Ans:Answer: c) Flange coupling**

UNIT	Q NO	QUESTIONS
2	57	What is the function of a key in a machine? (a) To lock the machine (b) To prevent relative rotational motion between a shaft and a hub (c) To support the shaft (d) To measure the shaft's speed **Ans:Answer: b) To prevent relative rotational motion between a shaft and a hub**
2	58	Why is a protected type flange coupling preferred over an unprotected one? (a) It is cheaper (b) It provides safety for workers (c) It transmits more power (d) It is lighter **Ans:Answer: b) It provides safety for workers**
2	59	Marine couplings are specifically designed for: (a) High torque industrial drives (b) Small gear assemblies (c) Ship propulsion systems (d) Electrical motors **Ans:Answer: c) Ship propulsion systems**
2	60	Pin-type couplings provide: (a) No flexibility (b) High alignment tolerance (c) Misalignment flexibility via rubber bushes (d) Frictional locking **Ans:Answer: c) Misalignment flexibility via rubber bushes**
2	61	In flange coupling, flange is generally fixed on the shaft using: (a) Nut and bolt (b) Key (c) Thread (d) Welding **Ans:Answer: b) Key**
2	62	In marine type flange couplings,the flanges are_____on the end of the shafts. (a) Forged (b) drawn (c) cut (d) weld **Ans:a) Forged**
2	63	Flexible couplings absorb: (a) Shaft tension (b) Axial load (c) Shock and vibration (d) Friction loss **Ans:Answer: c) Shock and vibration**
2	64	In rigid flange coupling, the key takes: (a) No torque (b) Half the torque (c) All the torque (d) None of the above **Ans:Answer: c) All the torque**

UNIT	Q NO	QUESTIONS
2	65	Which of the following is true for flange coupling? (a) Suitable for high misalignment (b) Difficult to manufacture (c) Suitable for low-speed drives (d) It has gear teeth **Ans:Answer: c) Suitable for low-speed drives**
2	66	If the shear stress in a key is 50 N/mm² and its shear area is 100 mm², what is the shearing force? (a) 500 N (b) 2 N (c) 5000 N (d) 0.5 N **Ans:Answer: c) 5000 N**
2	67	A flange coupling has 4 bolts. If the total shear force on the bolts is 20,000 N, what is the shear force on each bolt? (a) 4000 N (b) 5000 N (c) 20000 N (d) 80000 N **Ans:Answer: b) 5000 N**
2	68	A rigid flange coupling connects two shafts of 50 mm diameter. What is a suitable diameter for the hub? (a) 50 mm (b) 75 mm (c) 100 mm (d) 125 mm **Ans:Answer: c) 100 mm**
2	69	Calculate the power transmitted by a shaft rotating at 1500 rpm (approx. 157 rad/s) and transmitting a torque of 200 N-m. (a) 31.4 kW (b) 300 kW (c) 13.3 W (d) 7.5 kW **Ans:Answer: a) 31.4 kW**
2	70	A flange coupling is designed to transmit 15 kW at 900 rpm. Calculate the torque. (a) 159.1 N-m (b) 15000 N-m (c) 1.6 N-m (d) 900 N-m **Ans:Answer: a) 159.1 N-m**
2	71	A flange coupling is designed to transmit 15 kW at 500 rpm. Calculate the Torque. (a) 159.1 N-m (b) 15000 N-m (c) 286.5 N-m (d) 900 N-m **Ans:Answer: c) 286.5 N-m**
2	72	A flange coupling is designed to transmit 15 kW at 500 rpm with safe stress of 60 N/mm² for shaft. Calculate the standard diameter of shaft. (a) 40 mm (b) 30 mm (c) 25 mm (d) 20 mm **Ans:Answer: 30 mm**

UNIT	Q NO	QUESTIONS
2	73	A shaft must transmit 500 Nm of torque. If the maximum allowable shear stress is 60 MPa, what is the minimum required diameter? (a) 28 mm (b) 35 mm (c) 38 mm (d) 45 mm **Ans:Answer: b) 35 mm**
2	74	A flange coupling must transmit 1200 Nm of torque. The bolts are 10 mm in diameter and placed on a 200 mm pitch circle diameter. The permissible shear stress in the bolt material is 60 MPa. What is the minimum number of bolts required? (a) 2 (b) 4 (c) 3 (d) 8 **Ans:Answer: c) 3**
2	75	A flange coupling is used for a 50 mm diameter shaft. what is the outer diameter of the flange (Do)? (a) 100 mm (b) 125 mm (c) 150 mm (d) 200 mm **Ans:Answer: d) 200 mm**
2	76	Purpose of using key in a coupling: (a) Reduce friction (b) Transmit axial force (c) Transmit torque (d) Avoid wear **Ans:Answer: c) Transmit torque**
2	77	A key is generally subjected to which two types of stresses? (a) Tensile and Bending (b) Bending and Torsion (c) Shear and Crushing (d) Tensile and Compressive **Ans:Answer: c) Shear and Crushing**
2	78	Common key used in machine elements is: (a) Saddle key (b) Sunk key (c) Tangent key (d) Round key **Ans:Answer: b) Sunk key**
2	79	Which is not a key? (a) Feather key (b) Gib-head key (c) Hex key (d) Saddle key **Ans:Answer: c) Hex key**
2	80	A key is used to connect: (a) Belt and pulley (b) Shaft and hub (c) Gear teeth (d) Bolts and nuts **Ans:Answer: b) Shaft and hub**

UNIT	Q NO	QUESTIONS
2	81	A gib-head key is a type of sunk key that: (a) Is tapered (b) Has a head for easy removal (c) Is circular in cross-section (d) Does not use a keyway **Ans:Answer: b) Has a head for easy removal**
2	82	A key is generally made of: (a) Cast iron (b) Copper (c) Mild steel (d) Aluminum **Ans:Answer: c) Mild steel**
2	83	A feather key is a type of sunk key that allows for: (a) Easy removal (b) Axial movement of the hub on the shaft (c) Higher torque transmission (d) Misalignment **Ans:Answer: b) Axial movement of the hub on the shaft**
2	84	Which key does not require a keyway in the shaft? (a) Woodruff key (b) Feather key (c) Saddle key (d) Rectangular sunk key **Ans:Answer: c) Saddle key**
2	85	The shear stress in a key is equal to the crushing stress. This happens when the key is (a) Rectangular key (b) Square key (c) Tapered key (d) Feather key **Ans:Answer: b) Square key**
2	86	Effect of keyway on shaft strength results in: (a) Increase in torsional strength (b) No change (c) Reduction in torsional strength (d) Only tensile reduction **Ans:Answer: c) Reduction in torsional strength**
2	87	A Woodruff key is shaped like: (a) A rectangle (b) A square (c) A segment of a circular disc (d) A triangle **Ans:Answer: c) A segment of a circular disc**
2	88	The keyway cut into a shaft introduces: (a) Improved strength (b) Stress concentration (c) Better alignment (d) Reduced weight **Ans:Answer: b) Stress concentration**

UNIT	Q NO	QUESTIONS
2	89	In design, key failure is considered due to: (a) Bending only (b) Shear only (c) Shear and crushing (d) Torsion **Ans:Answer: c) Shear and crushing**
2	90	For high torque applications, the preferred key is: (a) Feather key (b) Sunk key (c) Saddle key (d) Round key **Ans:Answer: b) Sunk key**
2	91	Taper in standard key is: (a) 1:100 (b) 1:50 (c) 1:20 (d) 1:200 **Ans:Answer: a) 1:100**
2	92	In case of considering shear,key length (l) = (a) T / (w × h) (b) 2 ×T / (τ × d × w) (c) T/ (d × t) (d) T/ (l × t × h) **Ans:b) 2 ×T / (τ × d × w)**
2	93	A shaft of 60 mm diameter needs a rectangular sunk key. If the standard width is d/4 and thickness is d/6, what are the dimensions? (a) w=15 mm, t=10 mm (b) w=10 mm, t=15 mm (c) w=20 mm, t=12 mm (d) w=12 mm, t=10 mm **Ans:Answer: a) w=15 mm, t=10 mm**
2	94	A key of width 'w' transmits a torque 'T' on a shaft of diameter 'd'. The shearing force (F) on the key is calculated as: (a) F = T / d (b) F = 2T / d (c) F = T / w (d) F = T * d **Ans:b) F = 2T/d**
2	95	The shear strength of a key material is 300 MPa. If the factor of safety is 3, what is the allowable shear stress? (a) 900 MPa (b) 303 MPa (c) 297 MPa (d) 100 MPa **Ans:d) 100 MPa**
2	96	The crushing strength of a key is 400 MPa and the crushing stress induced is 100 MPa. What is the factor of safety? (a) 4 (b) 0.25 (c) 300 (d) 500 **Ans:a) 4**

UNIT	Q NO	QUESTIONS
2	97	If the diameter of a shaft is 40 mm, what is the standard width of a square sunk key? (w=d/4) (a) 4 mm (b) 40 mm (c) 10 mm (d) 160 mm **Ans:c) 10 mm**
2	98	If the force on a key is 6000 N and its length is 50 mm, what is the shear stress if the width is 12 mm? (a) 10 N/mm² (b) 120 N/mm² (c) 500 N/mm² (d) 1.2 N/mm² **Ans:a) 10 N/mm²**
2	99	The effect of a keyway is that it _____ the strength of the shaft. (a) Increases (b) Reduces (c) Has no effect on (d) Doubles **Ans:b) Reduces**
2	100	A square key has a side of 10 mm and a length of 60 mm. What is its shearing area? (a) 100 mm² (b) 600 mm² (c) 60 mm² (d) 70 mm² **Ans:b) 600 mm²**
3	101	Which of the following belts is most suitable for long-distance power transmission? (A) V-belt (B) Flat belt (C) Timing belt (D) Round belt **Ans:B) Flat belt**
3	102	In belt drives, the speed ratio is defined as: (A) Driver speed / Driven speed (B) Driven speed / Driver speed (C) (Driver + Driven speed)/2 (D) Driver speed * Driven speed **Ans:A) Driver speed / Driven speed**
3	103	The ratio of belt tensions (T1/T2) for a flat belt drive is given by: (A) e^(μθ) (B) μθ (C) log(μθ) (D) μ+θ **Ans:A) e^(μθ)**
3	104	Which material is commonly used for flat belts? (A) Rubber (B) Leather (C) Fabric (D) All of the above **Ans:D) All of the above**

UNIT	Q NO	QUESTIONS
3	105	Condition for maximum power transmission in flat belt occurs when: (A) Tension is maximum (B) Centrifugal tension = 1/3 of maximum tension (C) Velocity is zero (D) Slip is zero **Ans:B) Centrifugal tension = 1/3 of maximum tension**
3	106	The length of open flat belt drive is given by: (A) $L = 2C + \pi(d_2+d_1)/2 + (d_2-d_1)^2/4C$ (B) $L = 4\pi(d_2-d_1) + 2C$ (C) $L = 2\pi(d_2-d_1) + 4C$ (D) $L = 4C + \pi(d_2+d_1)/2 + (d_2-d_1)^2/2C$ **Ans:A) $L = 2C + \pi(d_2+d_1)/2 + (d_2-d_1)^2/4C$**
3	107	Which of the following is NOT a standard belt material? (A) Leather (B) Cotton (C) Rubber (D) Asbestos **Ans:D) Asbestos**
3	108	Which pulley has larger diameter in a speed reducing flat belt drive? (A) Driver (B) Driven (C) Idler (D) Both equal **Ans:B) Driven**
3	109	The length of the belt depends on the center distance and the _____. (A) Belt material (B) Pulley diameters (C) Belt speed (D) Power transmitted **Ans:B) Pulley diameters**
3	110	Creep in a belt is caused by: (A) The elongation and contraction of the belt as it passes from tight to slack side (B) The belt slipping on the pulley surface (C) The high operating temperature (D) The belt material being too old **Ans:A) The elongation and contraction of the belt as it passes from tight to slack side**
3	111	_____ are not made endless.There is a joint. (A) White belt (B) Flat belt (C) V-belt (D) Black belt **Ans:B) Flat belt**
3	112	In belt drives, the slack side has: (A) Higher tension (B) Lower tension (C) Same tension (D) No tension **Ans:B) Lower tension**

UNIT	Q NO	QUESTIONS
3	113	In a belt drive, the tight side is usually at the _____ and the slack side is at the _____. (A) Top, Bottom (B) Bottom, Top (C) Left, Right (D) It doesn't matter **Ans:B) Bottom, Top**
3	114	As per Indian standards, V belts are designated by: (A) thickness and nominal inside depth (B) surface and nominal inside edge (C) length and nominal inside thickness (D) Cross section and nominal inside length **Ans:D) Cross section and nominal inside length**
3	115	The main advantage of a V-belt over a flat belt is: (A) Higher cost (B) More slip (C) Compact design and higher power transmission (D) Lesser grip **Ans:C) Compact design and higher power transmission**
3	116	Which belt drive is most suitable for small centre distance? (A) Open belt (B) Crossed belt (C) V-belt (D) Rope drive **Ans:C) V-belt**
3	117	The "wedging action" is a key feature of which belt drive? (A) Flat belt drive (B) V-belt drive (C) Rope drive (D) Chain drive **Ans:B) V-belt drive**
3	118	What is "crowning" on a flat belt pulley? (a) Making the pulley surface flat (b) Adding grooves to the pulley (c) Making the pulley diameter slightly larger at the center (d) Making the pulley out of a special material **Ans:c) Making the pulley diameter slightly larger at the center**
3	119	The width of flat belt = (A) Maximum Tension on tight side / [Maximum Tension /mm width for number of plies] (B) Maximum compression on tight side/ [Maximum compression /mm width for plies] (C) Maximum Diameter for Tight side/ [Maximum Diameter/ mm width for number of plies] (D) Maximum Speed on tight / [Maximum Speed /mm width for number of plies] **Ans:A) Maximum Tension on tight side / [Maximum Tension /mm width for number of plies]**
3	120	A crossed belt drive provides: (A) Higher speed ratio (B) Same direction rotation (C) Opposite direction rotation (D) No slip **Ans:C) Opposite direction rotation**

UNIT	Q NO	QUESTIONS
3	121	Which factor does not affect centrifugal tension? (A) Mass of belt (B) Belt speed (C) Belt width (D) Belt length **Ans:D) Belt length**
3	122	The tension in the tight side of the belt is: (A) Equal to slack side (B) Less than slack side (C) Greater than slack side (D) Zero **Ans:C) Greater than slack side**
3	123	Arc of contact for cross flat belt drive is: (A) $\theta = 180° - [(d_2-d_1)/c \times 60°]$ (B) $\theta = 180° + [(d_2-d_1)/c \times 60°]$ (C) $\theta = 180° - [(d_2+d_1)/c * \times 60°]$ (D) $\theta = 180° + [(d_2+d_1)/c \times 60°]$ **Ans:D) $\theta = 180° + [(d_2+d_1)/c \times 60°]$**
3	124	The included angle (2α) of the V groove on the pulley is usually (A) 30° to 40° (B) 10° to 20° (C) 50° to 80° (D) 60° to 70° **Ans:A) 30° to 40°**
3	125	One advantage of V-belts is: (A) Can operate in wet conditions (B) Requires less maintenance (C) High speed capability (D) Self-aligning ability **Ans:B) Requires less maintenance**
3	126	Which one is not desired properties of a belt material? (A) high coefficient of friction (B) flexibility (C) strength, ductility (D) hardness **Ans:D) hardness**
3	127	Power transmitted in belts is proportional to: (A) Belt area(w x t) (B) Belt length(l) (C) (T1-T2) x v (D) (T1+T2) **Ans:C) (T1-T2) x v**
3	128	Calculate the speed ratio for a drive with a driver pulley diameter of 150 mm and a driven pulley diameter of 450 mm. (A) 1:3 (B) 3:1 (C) 1:2 (D) 2:1 **Ans:B)3:1**

UNIT	Q NO	QUESTIONS
3	129	A pulley with a diameter of 200 mm rotates at 1000 rpm. What is the linear speed of the belt (neglecting slip)? (A) 10.47 m/s (B) 20.94 m/s (C) 5.23 m/s (D) 200 m/s **Ans:A) 10.47 m/s**
3	130	The tensions in the tight and slack sides of a belt are 600 N and 200 N respectively. What is the effective tension for power transmission? (A) 800 N (B) 400 N (C) 600 N (D) 200 N **Ans:B) 400 N**
3	131	What is the tension ratio (T1/T2) if the tight side tension is 900 N and the slack side tension is 300 N? (A) 3 (B) 1200 (C) 600 (D) 0.33 **Ans:A) 3**
3	132	If the driver pulley rotates at 900 rpm and the speed ratio is 3, what is the speed of the driven pulley? (A) 2700 rpm (B) 900 rpm (C) 300 rpm (D) 1800 rpm **Ans:C) 300 rpm**
3	133	If T1 = 800 N and the tension ratio is 4, what is the slack side tension, T2? (A) 200 N (B) 3200 N (C) 804 N (D) 796 N **Ans:A) 200 N**
3	134	A belt is moving velocity at 30 m/s and has a mass of 1 kg/m. Find the centrifugal tension. (A) 30 N (B) 900 N (C) 60 N (D) 3 N **Ans:B) 900 N**
3	135	The centrifugal tension and velocity of belt are 320N and 20 m/s.What is the mass (kg/m) of belt? (A) 2 (B) 0.8 (C) 50 (D) 10 **Ans:B) 0.8**
3	136	The arc of contact and coefficient of friction of leather belt are 150° and 0.30. Find the ration of tension? (T1/T2) (A) 1.1933 (B) 2.0033 (C) 2.1933 (D) 3.1933 **Ans:C) 2.1933**

UNIT	Q NO	QUESTIONS
3	137	Calculate the width of pulley Wp, if the width of the belt Wb is 280 mm. (A) 303 mm (B) 318 mm (C) 378 mm (D) 298 mm **Ans:B) 318 mm**
3	138	The speed ratio of belt drive is 3. Diameter of an aluminium rolling (big) pulley is 1.2 m. Find out the diameter of motor (small) pulley? (A) 380 mm (B) 250 mm (C) 350 mm (D) 400 mm **Ans:D) 400 mm**
3	139	Initial tension is introduced by: (A) Reducing belt length (B) Pulling belts tightly over pulleys (C) Increasing pulley diameter (D) Adding idler pulley **Ans:B) Pulling belts tightly over pulleys**
3	140	For maximum power, centrifugal tension (Tc) is T/3. If the total maximum tension (T) is 600 N, what should Tc be? (A) 600 N (B) 300 N (C) 200 N (D) 100 N **Ans:C) 200 N**
3	141	A compressor receives the power from a motor rated at 30 kW at 1320 rpm by means of V belts. Which type of belt cross section is selected from power ratings of V belt? (A) A type section (B) B type section (C) C type section (D) E type section **Ans:C) C type section**
3	142	The design power Pd and power rating per belt Pb of V belt drive are 39.98 kW and 6.765 kW respectively. Determine the number of belts (n) required. (A) 9 (B) 6 (C) 4 (D) 8 **Ans:B) 6**
3	143	What is the load rating (per mm width per ply at 180° arc of contact at 10 m/s belt speed) for High speed duck belting (Light duty) and Fort duck belting (Heavy duty)? (A) 0.053 kW/mm/ply, 0.0489 kW/mm/ply (B) 0.033 kW/mm/ply, 0.0389 kW/mm/ply (C) 0.043 kW/mm/ply, 0.0389 kW/mm/ply (D) 0.023 kW/mm/ply, 0.0289 kW/mm/ply **Ans:D) 0.023 kW/mm/ply, 0.0289 kW/mm/ply**
3	144	In V-belts, pitch length refers to: (A) Outside length (B) Inside length (C) Neutral axis length (D) Width of belt **Ans:C) Neutral axis length**

UNIT	Q NO	QUESTIONS
3	145	The diameter of bigger and smaller pulleys are 840 mm and 280 mm. The centre distance between the pulley is 1.68 m. Find the arc of contact of the belt in degree. [Assume cross belt drive] (A) 222° (B) 220° (C) 160° (D) 216° **Ans:B) 220°**
3	146	The diameter of bigger and smaller pulleys are 840 mm and 280 mm. The centre distance between the pulley is 1.68 m. Find the arc of contact of the belt in degree. [Assume open belt drive] (A) 222° (B) 220° (C) 160° (D) 166° **Ans:C) 160°**
3	147	A leather belt which is 125 mm wide and 6 mm thick and stress in tight side is 2.75 N/mm². Determine the maximum tension on the tight side of the belt? (A) 2062.5 N (B) 1962.5 N (C) 1862.5 N (D) 2162.5 N **Ans:A) 2062.5 N**
3	148	The following data of V belt drive: Diameter of driving pulley = 150 mm, Speed of driving pulley = 1000 rpm. Find the velocity of belt (V). (A) 6.85 m/s (B) 8.85 m/s (C) 7.85 m/s (D) 5.67 m/s **Ans:C) 7.85 m/s**
3	149	The following data of V belt drive: Diameter of driven pulley = 500 mm, Diameter of driving pulley = 150 mm, Centre distance between the pulley = 925 mm. Find the Arc of contact of (θ) belt. (A) 147.3° (B) 157.3° (C) 137.3° (D) 127.3° **Ans:B) 157.3°**
3	150	The following data of V belt drive: Rated Power P = 7.5 kW, Service Factor Ks = 1.3, Correction Factor for Length Kl = 1.05 and Arc of contact Factor Kθ = 0.95. Find the design power Pd of V belt. (A) 7.8 kW (B) 6.8 kW (C) 8.9 kW (D) 9.8 kW **Ans:D) 9.8 kW**
4	151	What is the primary function of a bearing? (A) To connect shafts, hub and inserted key (B) To support a moving part and guide its motion (C) To transmit power and torque with speed (D) To stop motion at shock load condition **Ans:B) To support a moving part and guide its motion**
4	152	Bearings are broadly classified into _____ contact bearing and _____ contact bearings. (A) Sliding, Rolling (B) Fixed, Variable (C) Flexible, Rigid (D) Steady, Unsteady **Ans:A) Sliding, Rolling**

UNIT	Q NO	QUESTIONS
4	153	Sliding and Rolling contact bearing are also called as _____ bearing and _____ bearing. (A) Flexible, Rigid (B) Journal and Antifriction (C) Viscous, In-viscous (D) Compressible, Incompressible **Ans:B) Journal and Antifriction**
4	154	Which type of bearing supports loads perpendicular to the shaft axis? (A) Thrust bearing (B) Radial bearing (C) Journal bearing (D) Roller bearing **Ans:B) Radial bearing**
4	155	In thrust bearings, the load or force acts _____ of rotation of the moving parts. (A) nonlinear to the axis (B) curvilinear to the axis (C) along the axis (D) neutral axis **Ans:C) along the axis**
4	156	Which of the following is NOT a type of sliding bearing? (A) Full journal (B) Partial journal (C) Hydrostatic (D) Roller **Ans:D) Roller**
4	157	Which of the following is NOT a type of roller bearing? (A) Cylindrical roller bearing (B) Tapered roller bearing (C) Spherical roller bearing (D) Plain journal bearing **Ans:D) Plain journal bearing**
4	158	In Partial journal bearing, the angle of contact of the bearing with the journal is _____ being a common value. (A) 190∘ (B) 120∘ (C) 280∘ (D) 250∘ **Ans:B) 120∘**
4	159	In Full journal bearing, the angle of contact of the bearing with the journal is _____. (A) 190∘ (B) 180∘ (C) 280∘ (D) 360∘ **Ans:D) 360∘**
4	160	There is clearance between journal and the bearing. Full and partial journal bearing are known as _____. (A) clearance bearing (B) fitted bearing (C) allowance bearing (D) slipper bearing **Ans:A) clearance bearing**

UNIT	Q NO	QUESTIONS
4	161	The following is not an element of rolling contact bearing. (A) Outer race (B) Inner race (C) Cage (D) Collar **Ans:D) Collar**
4	162	Rolling contact bearings are preferred over sliding contact bearings because they: (A) Have higher friction (B) Require more lubrication (C) Have lower friction and longer life (D) Are cheaper **Ans:C) Have lower friction and longer life**
4	163	What is the function of a cage or separator in a ball bearing? (A) To carry the load (B) To keep the balls evenly spaced (C) To lubricate the bearing (D) To seal the bearing **Ans:B) To keep the balls evenly spaced**
4	164	Which material is suitable for general application of journal bearings? (A) stainless steel (B) Babbit metal (C) Cast iron (D) Aluminum **Ans:B) Babbit metal**
4	165	The material used for ball and roller bearings is: (A) low carbon chromium steel (B) high carbon chromium steel (C) fabric steel (D) bronze steel **Ans:B) high carbon chromium steel**
4	166	Anti friction bearing also known as _____ bearing. It has _____ of friction. (A) rolling Contact, lower coefficient (B) sliding contact, higher coefficient (C) thrust bearing, medium coefficient (D) saddle bearing, zero coefficient **Ans:A) rolling Contact, lower coefficient**
4	167	Which radial type ball bearing permits the misalignment of shaft within 2 to 3 degrees? (A) single row deep groove bearing (B) double row deep groove bearing (C) angular contact bearing (D) self-aligning bearing **Ans:D) self-aligning bearing**
4	168	Taper roller type thrust ball bearing have the rollers and race ways in _____ shape. (A) elliptical (B) rectangular (C) truncated cone (D) parabolic **Ans:C) truncated cone**

UNIT	Q NO	QUESTIONS
4	169	Which type of thrust ball bearing can carry both radial load and thrust load? (A) self-aligning bearing (B) spherical roller bearing (C) Needle roller bearing (D) Tapered roller bearing **Ans:D) Tapered roller bearing**
4	170	Which bearing type is used in automotive wheels? (A) Thrust bearing (B) Tapered roller bearing (C) Ball bearing (D) Journal bearing **Ans:B) Tapered roller bearing**
4	171	Which factor is NOT considered in Indian standard bearing designation? (A) Bore diameter (B) Types (C) Manufacturer logo (D) Type of service **Ans:C) Manufacturer logo**
4	172	Which material is suitable for high load application of sliding contact and ball bearings? (A) stainless steel (B) Babbitt metal (C) Cast iron (D) Brass or Bronze **Ans:D) Brass or Bronze**
4	173	Which material of non-metallic bearing is suitable for food processing equipment? (A) Carbon-graphite (B) Sodium-chloride (C) Silver-graphite (D) Carbon chloride **Ans:A) Carbon-graphite**
4	174	The designation of "NU" series in roller bearings adopted by SKF ball bearing company indicates: (A) Single row deep groove (B) Double row deep groove (C) Cylindrical roller bearing (D) Thrust bearing **Ans:C) Cylindrical roller bearing**
4	175	Diametral clearance (C) is the difference between the diameter of _____ and the diameter of _____. (A) bearing and journal (B) cotter and sleeve (C) hub and sleeve (D) flange and hub **Ans:A) bearing and journal**
4	176	Diametral clearance Ratio (C/D) is the ratio of diametral _____ to the diameter of _____. (A) flange and clearance (B) clearance and sleeve (C) hub and clearance (D) clearance and journal **Ans:D) clearance and journal**

UNIT	Q NO	QUESTIONS
4	177	Rubbing velocity (V) of journal is _____ m/s. (A) (π X D X N)/(60 X 1000) (B) (π X D X N)/(60 X 10) (C) (2×π×N×T)/60 (D) (60×P)/2×π×N **Ans:** **A) (π X D X N)/(60 X 1000)**
4	178	The factor ZN/p is known as _____. (A) Bearing Mckee's number (B) Bearing Characteristic number (C) Bearing Petroff's number (D) Bearing Lashe's number **Ans:B) Bearing Characteristic number**
4	179	Based on experiments, Mckee's obtained the following approximate equation for the coefficient of friction in a well lubricated full journal bearing: (A) μ=[0.456×ZN/p× c/D]+h (B) μ=[0.826×ZN/p×c/D]+r (C) μ=[0.326×ZN/p×D/c]+k (D) μ=[0.589×ZN/p×D/c]+w **Ans:C) μ=[0.326×ZN/p×D/c]+k**
4	180	Mass of oil required for artificial cooling is found by using the equation _____. (A) ma=(Qi−Qe)/ CtΔti (B) ma=(Qd−Qg)/cdΔpo (C) ma=(Qe−Qi)/CvΔao (D) ma=(Qg−Qd)/cpΔto **Ans:D) ma=(Qg−Qd)/cpΔto**
4	181	The unit of absolute viscosity (Z) 1 centi-poise is equal to how many m2Ns? i.e., 1cp=___Ns-m^2 or Pa-s (A) 1000 (B) 100 (C) 1/1000 (D) 1/ 100 **Ans:C) 1/1000**
4	182	What is the absolute viscosity of SAE 20 type lubricating oil for journal bearing at the temperature 65∘C? (A) 0.017 Pa-s (B) 0.170 Pa-s (C) 0.107 Pa-s (D) 0.701 Pa-s **Ans:A) 0.017 Pa-s**
4	183	A 3 kN load(P) is supported by a journal bearing of 35 mm diameter(D) and 75 mm long(L). Find out the bearing pressure(p). (A) 1.3333 N/mm2 (B) 1.1429 N/mm2 (C) 2.6333 N/mm2 (D) 3.7333 N/mm2 **Ans:B) 1.1429 N/mm2**
4	184	A 50 mm diameter(D) and 75 mm long(L) journal bearing is loaded with bearing pressure(p) of 2 MPa. Find out the Load(P) on the bearing. (A) 6000 N (B) 7000 N (C) 7500 N (D) 8000 N **Ans:C) 7500 N**

UNIT	Q NO	QUESTIONS
4	185	A Journal bearing of 60 mm diameter(D) and speed(N) of rotation 1450 rpm. Calculate the rubbing velocity(V) of bearing. (A) 3.5553 m/s (B) 2.5553 m/s (C) 1.5553 m/s (D) 4.5553 m/s **Ans:D) 4.5553 m/s**
4	186	A journal bearing carries a radial load(P) of 9 kN and rubbing velocity(V) at 9.456 m/s, and assume Coefficient of friction (μ) = 0.0705. Calculate the amount of Heat generated [Qg] for journal bearing. (A) 5999.832 J/s (B) 7999.832 J/s (C) 8999.832 J/s (D) 6999.832 J/s **Ans:A) 5999.832 J/s**
4	187	A 75 mm diameter (D) journal bearing 100 mm long (L) and temperature difference between bearing surface and ambient temperature of Δt=31∘C. Calculate the amount of heat dissipated [Qd] and assume light and medium construction. (A) 87.75 J/s (B) 37.21 J/s (C) 57.65 J/s (D) 67.55 J/s **Ans:B) 37.21 J/s**
4	188	A journal bearing carries a radial load(P) of 9 kN, rubbing velocity (V) at 9.425 m/s. The power lost in friction is 6 kW. Find out the coefficient of friction. (A) μ=0.17773 (B) μ=0.27773 (C) μ=0.07073 (D) μ=0.37073 **Ans:C) μ=0.07073**
4	189	The heat generated [Qg] and heat dissipated [Qd] of journal bearing are 695.139 J/s and 61.524 J/s. The temperature difference between outlet and inlet temperature of oil Δto =8∘C. Calculate the mass of required for artificial cooling. Specific heat of (A) 8.65 kg/min (B) 3.77 kg/min (C) 6.65 kg/min (D) 2.77 kg/min **Ans:D) 2.77 kg/min**
4	190	If heat dissipated [Qd] < heat generated [Qg], What is required to carry away the heat from the bearing? (A) Natural cooling (B) Artificial cooling (C) No cooling (D) Moderate Cooling **Ans:B) Artificial cooling**
4	191	Find the Sommerfeld number (S) and friction variable from dimensionless performance parameter for full journal bearing, if ratio between the length and diameter (L/D) is 1 and minimum film thickness variable (2ho/c) is 0.4. (A) S=0.121,μ(D/c)=3.22 (B) S=0.221,μ(D/c)=4.22 (C) S=0.321,μ(D/c)=5.22 (D) S=0.421,μ(D/c)=6.22 **Ans:A) S=0.121,μ(D/c)=3.22**
4	192	Find the value of L/D ratio, allowable bearing pressure(p) N/m2 and minimum operating bearing characteristic number ZN/p ×10−6 for a centrifugal pump from design parameters for journal bearing. (A) L/D=2.6, p=2.4, (ZN/p) min×10−6=38.44 (B) L/D=1.6, p=1.4, (ZN/p)min×10−6=28.44 (C) L/D=0.6, p=0.4, (ZN/p) min×10−6=00.44 (D) L/D=3.6, p=3.4, (ZN/p)min×10−6=38.44 **Ans:B) L/D=1.6, p=1.4, (ZN/p)min×10−6=28.44**

UNIT	Q NO	QUESTIONS
4	193	Heat generated of the bearing [Qg] J/s = _____. (A) μ×D×C (B) μ×L×D (C) μ×P×V (D) μ×Z×V **Ans:C) μ×P×V**
4	194	Heat dissipated of the bearing [Qd] J/s = _____. (A) P.D.(Δt+28)2 / C×106 (B) V·D (Δt+38)2/ S×106 (C) R·D(Δt+48)2 / H×106 (D) L·D(Δt+18)2 /K×106 **Ans:D) L·D(Δt+18)2 /K×106**
4	195	A 100 mm diameter(D) and 100 mm long(L) journal bearing is loaded with bearing pressure(p) of 0.5 MPa. Find out the Load (P) on the bearing. (A) 6000 N (B) 5000 N (C) 7500 N (D) 8000 N **Ans:B) 5000 N**
4	196	A Journal bearing of 50 mm diameter(D) and speed(N) of rotation 500 rpm. Calculate the rubbing velocity(V) of bearing. (A) 2.309 m/s (B) 3.309 m/s (C) 1.309 m/s (D) 4.309 m/s **Ans:C) 1.309 m/s**
4	197	A 9 kN load(P) is supported by a journal bearing of 500 mm diameter(D) and 150 mm long(L). Find out the bearing pressure(p). (A) 0.14 N/mm2 (B) 0.13 N/mm2 (C) 0.15 N/mm2 (D) 0.12 N/mm2 **Ans:D) 0.12 N/mm2**
4	198	A journal bearing carries a radial load(P) of 20kN and rubbing velocity(V) at 4.7124 m/s, and assume Coefficient of friction (μ) = 0.0051. Calculate the amount of Heat generated [Qg] for journal bearing. (A) 480.665 J/s (B) 370.215 J/s (C) 557.656 J/s (D) 687.545 J/s **Ans:A) 480.665 J/s**
4	199	A 100 mm diameter (D) journal bearing 160 mm long (L) and temperature difference between bearing surface and ambient temperature of tb−ta=19.75∘C. Calculate the amount of heat dissipated [Qd] and heat dissipation coefficient Cd=1232 J/s/m2/∘C. (A) 689.312 J/s (B) 389.312 J/s (C) 889.312 J/s (D) 789.312 J/s **Ans:B) 389.312 J/s**
4	200	Bearing characteristic number of journal bearing for centrifugal pump ZN/p=30×10−6, bearing pressure(p) of 1.0352×106 N/m2 and speed (N) of 1440 rpm. Find out the absolute viscosity of oil. (A) 0.1216 Ns/m2 (B) 0.2216 Ns/m2 (C) 0.0216 Ns/m2 (D) 0.4516 Ns/m2 **Ans:C) 0.0216 Ns/m2**

UNIT	Q NO	QUESTIONS
5	201	CAD stands for _____. (A) Computer Advanced Decorating (B) Computer Analysis Decoding (C) Computer Aided Design (D) Common Application Development **Ans:C) Computer Aided Design**
5	202	What is the primary role of CAD in design? (A) Manufacturing only (B) Designing and development (C) Testing software (D) Data storage **Ans:B) Designing and development**
5	203	Which of the following is an advantage of CAD? (A) Increased manual effort (B) Improved accuracy (C) Limited design options (D) Slower production **Ans:B) Improved accuracy**
5	204	AutoCAD software is developed and marketed by _____. (A) Autodesk, Inc. (B) Microsoft (C) Intel (D) HCL **Ans:A) Autodesk, Inc.**
5	205	Which one is not performed as engineering analysis in CAD? (A) Mass property calculation (B) Simulation (C) Finite Element Analysis (D) Process Techniques **Ans:D) Process Techniques**
5	206	CAD system can not be used to do _____. (A) Two-Dimensional Drafting (B) Three-Dimensional Modelling (C) Interactive Computer Graphics (D) Beauty and Cooking Modernization **Ans:D) Beauty and Cooking Modernization**
5	207	The one of following is not a major CAD/CAM system: (A) CATIA (B) IDEAS (C) Solid Works (D) Hollow Works **Ans:D) Hollow Works**
5	208	How many steps involved in Shigley's Design Process? (A) Ten (B) Six (C) Four (D) Three **Ans:B) Six**

UNIT	Q NO	QUESTIONS
5	209	In Shigley's design process, SYNTHESIS means _____. (A) preliminary ideas are developed (B) perception of a product (C) design meet specification (D) characteristics and performance **Ans:A) preliminary ideas are developed**
5	210	What is a major advantage of using CAD? (A) It requires less skilled operators (B) It is a slow process in design (C) It increases productivity and accuracy (D) It eliminates the need for design engineers **Ans:C) It increases productivity and accuracy**
5	211	In the 'Sequential Engineering' design process, each stage is completed: (A) In parallel (B) One after another in a sequence (C) By the same person (D) In a random order **Ans:B) One after another in a sequence**
5	212	'Concurrent Engineering' involves: (A) A slow and steady design process (B) Overlapping design and development phases to save time (C) Only the design team working on a project (D) A focus on individual tasks **Ans:B) Overlapping design and development phases to save time**
5	213	What is the main goal of 'Value Engineering'? (A) To increase the cost of the product (B) To improve the function of a product while reducing its cost (C) To use the most expensive materials (D) To make the product look good, regardless of function **Ans:B) To improve the function of a product while reducing its cost**
5	214	The 'Lean Manufacturing' system primarily focuses on: (A) Maximizing waste (B) Using as many resources as possible (C) Minimizing waste and maximizing value (D) Having a large inventory **Ans:C) Minimizing waste and maximizing value**
5	215	Sequential Engineering is often called as _____ method. (A) across the wall (B) boundary wall (C) circular wall (D) parallel wall **Ans:A) across the wall**
5	216	Concurrent Engineering is also called as _____. (A) Simultaneous Engineering (B) Structural Engineering (C) Computer Engineering (D) Automotive Engineering **Ans:A) Simultaneous Engineering**

UNIT	Q NO	QUESTIONS
5	217	Concurrent Engineering is referred to as _____. (A) non parallel engineering (B) parallel engineering (C) process engineering (D) systematic engineering **Ans:B) parallel engineering**
5	218	DFMA stands for _____. (A) Design for Marketing and Addressing (B) Design for Making and Arrangement (C) Design for Manufacturing and Assembly (D) Design for Modelling and Analysis **Ans:C) Design for Manufacturing and Assembly**
5	219	Lean Manufacturing focuses on: (A) High inventory (B) Streamlined processes (C) Increased downtime (D) Manual techniques **Ans:B) Streamlined processes**
5	220	Value Engineering optimizes the _____ of a product. (A) cost (B) availability (C) property (D) process **Ans:A) cost**
5	221	The process of creating a mathematical description of a 3D object is called: (A) Geometric Modelling (B) Product Testing (C) Market Analysis (D) Financial Planning **Ans:A) Geometric Modelling**
5	222	CSG Stands for _____. (A) Commercial Sold Good (B) Constructive Solid Geometry (C) Combined Surface Generative (D) Conditional System Guidance **Ans:B) Constructive Solid Geometry**
5	223	Geometric models can be classified as _____. (A) Quantity and Quality model (B) Planning and Processing model (C) 2D drafting and 3D model (D) 4D drafting and 8D model **Ans:C) 2D drafting and 3D model**
5	224	Geometric modelling aids in: (A) Financial reports (B) 3D object simulation (C) Video production (D) Audio recording **Ans:B) 3D object simulation**

UNIT	Q NO	QUESTIONS
5	225	Solid modelling provides: (A) 2D outlines (B) Realistic 3D structures (C) Simple sketches (D) Text documents **Ans:B) Realistic 3D structures**
5	226	Which one is not for representation for Three-dimensional (3D) model? (A) Wire frame model (B) Surface model (C) Solid model (D) Organic model **Ans:D) Organic model**
5	227	Which of the following is a type of solid modelling approach? (A) Line Representation Geometry (LRG) (B) Surface Representation Geometry (SRG) (C) Constructive Solid Geometry (CSG) (D) Point Representation Geometry (PRG) **Ans:C) Constructive Solid Geometry (CSG)**
5	228	Constructive Solid Geometry (CSG) creates complex objects by: (A) Drawing lines and arcs shapes using trigonometry operations (B) Stitching surfaces together using Pythagoras theorem (C) Combining simple primitive shapes using Boolean operations (D) Manually defining all vertices and edges **Ans:C) Combining simple primitive shapes using Boolean operations**
5	229	Boundary Representation (B-rep) defines a solid by its: (A) Internal volume (length, width, thickness) (B) Enclosing surfaces (faces, edges, and vertices) (C) Primitive shapes (square, rectangular, triangular) (D) Mass and density (low, medium, high) **Ans:B) Enclosing surfaces (faces, edges, and vertices)**
5	230	Which solid modelling approach is generally considered less ambiguous and more robust? (A) Wireframe Modelling (WM) (B) Surface Modelling (SM) (C) Boundary Representation (B-rep) (D) 2D Drafting (2DD) **Ans:C) Boundary Representation (B-rep)**
5	231	What does 'FEA' stand for? (A) Finite Element Analysis (B) Fast Engineering Application (C) Final Engineering Approval (D) Fictional Element Algorithm **Ans:A) Finite Element Analysis**
5	232	FEA is a numerical method used for: (A) Creating 3D models for evaluation and presentation under condition (B) Simulating how a component or assembly behaves under various physical conditions (C) Generating manufacturing drawings with specification in detailed condition (D) Managing product data verification and analysing under various condition **Ans:B) Simulating how a component or assembly behaves under various physical conditions**

UNIT	Q NO	QUESTIONS
5	233	Which modelling technique is best for creating photorealistic images? (A) Wireframe modelling (B) Solid modelling (C) 2D drafting (D) Stick-figure drawing **Ans:B) Solid modelling**
5	234	Boolean operations in CSG include: (A) Draw, Trim, Extend (B) Union, Intersection, Difference (C) Pan, Zoom, Rotate (D) Fillet, Chamfer, Shell **Ans:B) Union, Intersection, Difference**
5	235	Which stage is not defined for the Product life cycle? (A) Growth (B) Maturity (C) Decline (D) Design **Ans:D) Design**
5	236	The main advantage of B-rep over CSG is its ability to: (A) Represent and easy to construct simpler objects (B) less memory storage space is required (C) Non analytical and complicated surfaces can be created (D) Use Boolean operations easily **Ans:C) Non analytical and complicated surfaces can be created**
5	237	Prototyping reduces: (A) Design errors (B) Production costs (C) Marketing time (D) Software bugs **Ans:A) Design errors**
5	238	The "Difference" or "Subtract" Boolean operation is used to: (A) Combine two objects into one (B) Create an object that is the shared volume of two objects (C) Cut away one object's volume from another (D) Make two objects identical **Ans:C) Cut away one object's volume from another**
5	239	What type of elements are used in a B-rep model? (A) Frame elements (B) Primitive shapes (C) Topological elements (D) Boolean operations **Ans:C) Topological elements**
5	240	'Rapid Prototyping' refers to: (A) Sketching ideas quickly on paper from IR (B) Build physical models directly from CAD data (C) Testing a product rapidly from SCAN (D) Manufacturing a product quickly from UV **Ans:B) Build physical models directly from CAD data**

UNIT	Q NO	QUESTIONS
5	241	Representation of Solid models are superior to surface models because they contain: (A) Only surface information (B) Volumetric information (C) Only edge information (D) Only colour information **Ans:B) Volumetric information**
5	242	What "primitives" are used as the solid objects of CSG? (A) An advanced, complex shape of objects (B) cube, sphere, cylinder, cone (C) A hand-drawn sketch object (D) A final assembly object **Ans:B) cube, sphere, cylinder, cone**
5	243	Lean Manufacturing improves _____. (A) Waste production (B) Operational efficiency (C) Design complexity (D) High inventory **Ans:B) Operational efficiency**
5	244	Which type of model represents an object using only lines and curves? (A) Solid model (B) Surface model (C) Wireframe model (D) B-rep model **Ans:C) Wireframe model**
5	245	In FEA, a model is divided into a finite number of small 'elements', which are connected to each other at points called _____. (A) entity (B) nodes (C) model (D) region **Ans:B) nodes**
5	246	Which of the following would be an application of CAD? (A) Writing an email (B) Designing a car engine (C) Calculating company payroll (D) Creating a music playlist **Ans:B) Designing a car engine**
5	247	Constructive solid geometry approach is also called as _____. (A) house construct approach (B) building block approach (C) wire construct approach (D) frame construct approach **Ans:B) building block approach**
5	248	Which one is not an FEA software? (A) CATIA (B) ANSYS (C) ABAQUS (D) INTEL **Ans:D) INTEL**

UNIT	Q NO	QUESTIONS
5	249	In solid model, C-rep means _____. (A) Control Reproduce (B) Connected Respect Service (C) Constructive Solid Geometry (D) Combined Scalar Graph **Ans:C) Constructive Solid Geometry**
5	250	The best method for three-dimensional model construction is the _____. (A) Hollow Modelling Techniques (B) Solid Modelling Techniques (C) Cartoon Drawing Techniques (D) Decoration Model Techniques **Ans:B) Solid Modelling Techniques**

UNIT – 1

PART B (*Short answer questions each question carries **3marks)***

1. What are the factors that affect the selection of materials for the design of machine elements?
2. Name the type of steel andits composition to the following designation:

   XT72 W18 Cr4 V1
3. Define factor of safety for ductile and brittle materials.
4. Briefly explain the creep curve with three stages
5. Briefly explain the S-N Curve?
6. What are the remedies taken to reduce the stress concentration?
7. A knuckle joint is subjected to a pull of 115 kN. The fork end and the rod end are connected using a pin and its subjected to the double shear. Permissible shear stress of the pin is 60 N/mm^2. Calculate the diameter of the pin.
8. A circular steel bar of 20 mm diameter carries a tensile load of 30kN. Find the tensile stress in the bar and the elongation in a length of 300 mm, if E= $2X10^5$ N/mm^2.
9. A hydraulic press exerts a total load of 3.5MN, which is carried by two steel rods of 2.5 m long supporting the upper head of the press. If the safe stress is 85 MPa. Calculate the diameter of the rod.
10. A steel rope of $100mm^2$ cross sectional area is made up of strands (threads of rope) 1mm in diameter having an allowable tensile stress of 168 N/mm^2 and an ultimate strength of 130 kN. The factor of safety is 8. If the area of 10 broken strands is 7.854 mm^2, find the calculated working stress, is the rope fit for further use?
11. Two materials have the same tensile strength but different ductility. Evaluate which material would be more suitable for a component subjected to sudden loading and justify your choice.
12. A component is manufactured using a composite material instead of a conventional steel material. Analyse two advantages and one limitation of using the composite material.

UNIT – II

PART B (*Short answer questions each question carries **3marks)***

13. How are the types of coupling classified?
14. Sketch a protective type flange coupling and indicate its various dimensions.
15. State the advantages of bushed pin type flexible coupling?
16. The standard cross section of a flat key, which is fitted on a 50 mm diameter shaft is 16 X 10 mm. The key is transmitting torque of 475 Nm from shaft to the hub. The allowable crushing stress for key material is 80 N/mm^2. Determine the length of key required.
17. A pulley is connected to the 30 mm diameter of shaft by means of a key and the torque is transmitted at 425000 Nmm. Find the dimensions of the key so that the shear stress in the key does not exceed 50 MPa and length of the key is 4 times its width.
18. In a flange coupling, the diameter of the shaft is 30mm, Find the other dimensions: Thickness of the flange (t_f), Length of the hub for each flange (L), Outer diameter of the hub (D) and Outer diameter of flange (D_O)
19. In a flange coupling the transmitted torque is 286500 Nmm.The outer diameter of the hub D =60mm and the diameter of the shaft d= 30 mm. Determine the induced shear stress (τ_f) in the hub material?
20. In a flange coupling with four bolts, the transmitted torque 286500 Nmm, pitch circle diameter of bolt d_p = 110 mm and shear stress for bolt material is 60 N/mm^2. Find the standard diameter of bolt (d_b).
21. A marine flange coupling is used to transmit power 2.7 MW at 90 rpm. with a working shear stress of 63 N/mm^2. Calculate the diameter of the shaft.
22. In a marine type flange coupling with eight bolts,the transmitted torque is 6200000 Nmm, pitch circle diameter of bolt d_p = 160 mm and shear stress for bolt material is 33 N/mm^2. Find out the standard diameter of bolt (d_b).
23. A key is designed only for shear strength, but its crushing stress exceeds the allowable value. Analyse why the key is unsafe and explain how changing the key length can improve its crushing strength.
24. A flange coupling has six bolts instead of four bolts while transmitting the same torque at the same pitch-circle diameter. Analyse how increasing the number of bolts affects the load carried by each bolt and the required bolt diameter.

UNIT – III

PART B (*Short answer questions each question carries **3marks)***

25. Write short notes on belt materials.?
26. Sketch the open and cross belt drives with their notations and uses.
27. Sketch the cross section of V belt and label its important parts.
28. Compare the flat belt with V belt.
29. In a flat belt drive, the diameters of bigger and smaller pulleys are 840 mm and 280 mm. The centre distance between the pulleys is 1.68 m. Find the arc of contact of the belt in radians. [Assume an open belt drive].Also, find the ratio of tension, if coefficient of friction is 0.2.
30. The diameters of driven pulley and driver pulleys are 1200 mm and 400 mm. The driver pulley rotates at 740 rpm. The centre distance between the pulleys is 3 m. Find the length of flat belt. [Assume cross belt drive] and the velocity of belt.
31. A leather flat belt transmits 22.5 kW power to an aluminium rolling machine. The arc of contact factor and the small pulley diameter correction factor are 1.064 and 0.9 respectively. Find the design power of belt P_d and assume the service factor for shock load.
32. The following data is available for V belt drive: Diameter of driven pulley = 500 mm, Diameter of driving pulley = 150mm. Centre distance between the pulleys = 925 mm. Power transmitted = 7.5 kW. Find the standard value of pitch length (l_p) of belt.
33. A compressor receives power from a motor rated at 7.5 kW and velocity 7.85 m/s by means of V belts. Small pulley diameter and diameter factor are $d_1 = 150\ mm\ k_d$=1.14 per belt respectively. Calculate the power rating per belt P_b.
34. In B type cross section V-belt drive, the diameters of driving pulley and driven pulley are 150 mm and 500 mm. Find the (i) Outer and core diameter of driving pulley and (ii) Outer and core diameter of driven pulley, and (iii) Width of the pulley, if the number of the belt is 5.
35. A belt drive is experiencing frequent belt slip even though the belt speed is within the recommended range. Identify the possible causes and suggest suitable design or operating modifications to improve power transmission.
36. A V-belt drive is producing excessive vibration and premature belt wear. Analyse the possible causes related to pulley alignment, belt tension and pulley groove condition, and suggest suitable corrective measures.

UNIT – IV

PART B (*Short answer questions each question carries **3marks)***

37. How are bearing classified?
38. Sketch a ball rolling contact bearing and label its important parts.
39. Briefly explain bearing characteristic number with the graph plotted by Mckee's brothers.
40. A 50 mm diameter and 75 mm long journal bearing is loaded with bearing pressure of 2 MPa. The shaft in bearing rotates at 500 rpm. Find the heat generated [Q_g] of the bearing. Take coefficient of frictionμ = 0.0015.
41. A journal bearing has a 50 mm diameter and is 75 mm long. Heat dissipated from the bearing is 14.75 J/s and heat is lost from the surface at the rate of 11.6 J/m^2/s/℃ . The housing area is 8 times the projected area. If the room temperature is 28 ℃, determine the surface temperature of bearing.
42. The coefficient of friction in a well lubricated journal bearing is 0.0063, the pressure is 0.3333 N/mm^2 and it rotates at 600 rpm. Take D/C = 1000 and correct end leakage factor k = 0.002. Find the viscosity of oil.
43. The mass flow rate of oil required for journal bearing of 0.0036536 kg/s, specific heat of oil is 1720 J/kg/K and heat generated by the bearing is 93.556 J/s. Find the increase in oil temperature [Δt_0].
44. A suitable journal bearing for a centrifugal pump form the following data: Load on the bearing (P) =13.25 kN. Diameter (D) and Length (L) of bearing are 80 mm and 160 mm. The rubbing velocity is 6.032 m/s and coefficient of friction μ = 0.0104. Assume a heavy construction bearing with K = 0.273 ℃ /m^2/W and Δt = 22.5℃. Compare the heat generated and the heat dissipated for the bearing. What type of cooling is required for bearing?
45. The heat generated[Q_g] and heat dissipated [Q_d] of the journal bearing are 480.665 J/s and 389.312 J/s. Calculate the mass flow rate of oil required for artificial cooling, if the specific heat [C_p] of oil 1710 J/kg K and temperature difference between outlet and inlet [Δt_0] is 10 ℃.
46. A journal bearing 300 mm long and 150 mm diameter carries a radial load of 9 kN at 1200 rpm. The power lost in friction is 6 kW. Viscosity of oil at room temperature is 0.018 Pa-s. Find the diametral clearance.
47. A journal bearing shows excessive temperature during continuous operation even though the applied load is within the allowable value. Identify possible causes related to friction, lubrication and heat dissipation, and suggest suitable corrective measures.
48. A machine operates under heavy radial load at moderate speed. Compare sliding-contact and rolling-contact bearings and recommend the more suitable type based on load capacity, friction, maintenance and application requirements.

UNIT – V

PART B (*Short answer questions each question carries **3marks)***

49. Describe the role of CAD activities in Shigley's design process.
50. Write the important applications of CAD.
51. List out the advantages of CAD
52. Briefly explain the sequential engineering with diagram.
53. Briefly explain the concurrent engineering with diagram.
54. List out the techniques and advantages of lean manufacturing.
55. Compare CSG and B-rep.
56. State the advantages of solid modelling.
57. List out the three phases, advantages and application of Finite Element Analysis.
58. List out the major techniques used in New Product Development.
59. A designer wants to calculate the volume, mass, centre of gravity and moment of inertia of a machine component before manufacturing. Evaluate why solid modelling is preferable to wire-frame modelling for these design activities.
60. A new product repeatedly fails during testing because design changes are introduced late in development. Analyse how concurrent engineering and early FEA can reduce such late-stage design problems.

PART C (*Short answer questions each question carries **10 marks)***

1 What are the causes of stress concentration? Explain the methods of reducing it.

2 A hydraulic press exerts a total load of 3.5 MN, which is carried by two steel rods of 2.5 m length, supporting the upper end of the press. If the safe stress is 85 MPa and E = 210 kN/mm², calculate: (i) the diameter of the rods, and (ii) the extension in each rod.

3 A knuckle joint is subjected to a pull of 80 kN. If the maximum permissible tensile stress in the rods is 100 N/mm² and the permissible shear stress in the pin is 80 N/mm², calculate:
(i) the diameter of the rods, and
(ii) the diameter of the pin.

4 A mild steel rod supports a tensile load of 50 kN and the stress in the rod is limited to 100 N/mm². Determine the size of the rod when the cross-section is: (a) circular, (b) square, and (c) rectangular with width = 3 × thickness.

5 In a steam engine cylinder of 300 mm diameter, the maximum pressure across the piston is 0.65 N/mm². Determine the diameter of the piston rod, if the maximum tensile or compressive stress on the piston rod is limited to 40 N/mm².

6 Tensile Member – Application & Analysis: A steel tie rod of 24 mm diameter is subjected to an axial tensile load of 42 kN. The rod is 1.8 m long and Young's modulus is 2×10^5 N/mm². (a) Determine the tensile stress developed in the rod. (3 Marks) (b) Calculate the elongation of the rod. (3 Marks) (c) If the working stress is 250 MPa, calculate the factor of safety of the tie rod and evaluate whether the rod is safe under the given loading condition. (4 Marks)

UNIT – II

PART C (*Short answer questions each question carries **10 marks)***

1 Design a protected type flange coupling to connect two shafts to transmit 7.5 kW at 720 rpm. The permissible shear stress for the shaft, bolt, and key materials is 33 N/mm². The permissible crushing stress for the bolt and key material is 60 N/mm², and the permissible shear stress for cast iron is 15 N/mm².

2 Design a C.I. rigid flange coupling to transmit 15 kW at 90 rpm from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used: Shear stress for shaft, bolt, and key material = 40 N/mm², Crushing stress for bolt and key = 80 N/mm², Shear stress for C.I. = 8 N/mm².

3 A marine type coupling is used to transmit 3.75 MW at 150 rpm. The allowable shear stress in the shaft and bolts may be taken as 50 N/mm². Find: (a) the shaft diameter, and (b) the diameter of the bolts.

4 Design a rectangular key for a mild steel shaft transmitting 16 kW at 900 rpm. The diameter of the shaft is 40 mm and the length of the key is 80 mm. The shear stress and crushing stress for mild steel are 52 N/mm² and 116 N/mm², respectively.

5 The standard cross-section of a flat key, which is fitted on a 50 mm diameter shaft, is 16 × 10 mm. The key is transmitting 475 N·m torque from the shaft to the hub. The allowable shear stress and

compressive stress of the key material may be taken as 45 N/mm² and 80 N/mm², respectively. Determine the length of the key required.

6 Protected Cast-Iron Flange Coupling – Design and Verification: Design and draw a protected cast-iron flange coupling for a steel shaft transmitting 15 kW at 200 rpm with an allowable shaft shear stress of 40 N/mm². The working stress in the bolts should not exceed 30 N/mm². The same material is used for the shaft and key, and the crushing stress is twice the value of the shear stress. The maximum torque is 25% greater than the full-load torque. The allowable shear stress for cast iron is 14 N/mm². Apply the coupling design procedure to: (a) Calculate the full-load torque and maximum design torque. (2 Marks) (b) Determine the shaft diameter based on the allowable shear stress. (2 Marks) (c) Design the key and bolts considering shear and crushing conditions. (3 Marks) (d) Determine suitable dimensions for the hub and flange. (2 Marks) (e) Verify the design for hub, key, flange and bolts and justify the final dimensions. (1 Mark)

UNIT – III

PART C (*Short answer questions each question carries **10 marks)***

1 Design a fabric belt to transmit 11 kW at 420 rpm of an engine to a line shaft running at 20 rps. The engine pulley diameter is 550 mm, and the centre distance is 2 m. Assume the number of plies = 6.

2 Design a V-belt drive to the following specifications: Power to be transmitted: 75 kW, Speed of driving wheel: 1440 rpm, Speed of driven wheel: 400 rpm, Diameter of driving wheel: 300 mm, Centre distance: 2500 mm, Small pulley factor, Small pulley factor $K_d = 1.14$, Service factor Ks = 1.3, Correction factor for length $K_l = 1.07$.

3 A V-belt drive is to transmit 15 KW to a compressor. The motor speed is 1200 rpm and the compressor pulley runs at 400 rpm. Determine the size and number of belts required.

4 A compressor receives power from a motor rated at 30 kW at 1320 rpm by means of V-belts. The pulley diametersare300 mmand750mm.Centre distance is 1.4m. Design the drive. Take K_d= 1.2.

5 Design a flat belt drive to transmit 22.5 kW at 740 rpm to an aluminium rolling machine with a speed ratio of 3, where the distance between the pulleys is 3 m and the diameter of the rolling machine pulley is 1.2 m. Assume the following: a load correction factor Ks = 1.5, a pulley correction factor Kd = 0.9.

6 V-Belt Drive – Design and Analysis: Design a V-belt drive and determine the actual belt tensions and average belt stress using the following data: Diameter of driven pulley = 500 mm; Diameter of driving pulley = 150 mm; Centre distance between pulleys = 925 mm; Speed of driving pulley = 1000 rpm;

Power transmitted = 7.5 kW. Apply the standard V-belt design procedure to: (a) Determine the speed of the driven pulley and the required speed ratio. (2 Marks) (b) Calculate the approximate belt length and determine the angle of contact on the smaller pulley. (2 Marks) (c) Select a suitable V-belt section and determine the number of belts required for the given power. (2 Marks) (d) Calculate the actual tight-side and slack-side belt tensions and determine the average stress in the belt. (3 Marks) (e) Evaluate the designed drive for safe and reliable operation. (1 Mark)

UNIT – IV

PART C (*Short answer questions each question carries **10 marks)***

1 A 150 mm diameter shaft supporting a load of 10 kN has a speed of 1500 rpm. The shaft runs in a bearing whose length is 1.5 times the shaft diameter. If the diametral clearance of the bearing is 0.15 mm and the absolute viscosity of the oil at the operating temperature is 0.011 kg/m·s, find the power wasted in friction.

2 A journal bearing 300 mm long and 150 mm diameter carries a radial load of 9 kN at 1200 rpm. The power lost in friction is 6 kW. The viscosity of oil at room temperature is 0.018 Pa·s. Find the diametral clearance.

3 A 50 mm diameter and 75 mm long journal bearing is loaded with a bearing pressure of 2 MPa. The shaft in the bearing rotates at 500 rpm. Heat is lost from the surface at the rate of 11.6 J/m²·s·°C. The housing area is 8 times the projected area. If the room temperature is 28°C, determine the surface temperature of the bearing. Take $\mu = 0.0015$.

4 In a bearing, the load on the journal is 40,000 N, diameter = 150 mm, speed = 900 rpm, ambient temperature = 15.5°C, and the temperature of the oil film for SAE 10 oil is 50°C. The L/D ratio = 1.6, bearing pressure = 111.1×10^4 N/m², and C/D = 0.0013. The absolute viscosity of SAE 10 oil is 0.17 N·s/m².Determine: The coefficient of friction, The heat generated.

5 Design a journal bearing for a centrifugal pump from the following data:
Load on the journal: 20 kN, Speed of journal: 900 rpm, Diameter of journal: 100 mm, L/D ratio: 1.6. Type of oil used: SAE 10, for which the absolute viscosity at 55°C = 17 cP, Ambient temperature: 15.5°C, Maximum bearing pressure: 1.5 N/mm², Heat dissipation coefficient: 1232 J/s/m²/°C, Calculate the mass of lubricating oil required for artificial cooling, if the rise in temperature of oil is limited to 10°C. Take the specific heat of oil as 1710 J/kg·K.

6 Journal Bearing – Maximum Speed Based on Heat Dissipation: A 3 kN load is supported by a journal of 75 mm diameter and 75 mm length. The diametral clearance is 0.05 mm and the bearing is lubricated with oil having a viscosity of 0.0207 Pa·s at operating temperature. The bearing is capable of dissipating 80 W by heat transfer. Apply the principles of frictional heat generation and thermal equilibrium to: (a)

Determine the projected bearing area and bearing pressure. (2 Marks) (b) Calculate the bearing characteristic for the given operating conditions. (2 Marks) (c) Determine the coefficient of friction. (2 Marks) (d) Establish the relationship between frictional power loss and rotational speed. (2 Marks)

UNIT – V

PART C (*Short answer questions each question carries **10 marks)***

1 Explain the Shighley model of design process with a flow chart.

2 Explain sequential engineering and concurrent engineering with a sketch.

3 Explain with an example how solid objects are created in solid modeling by performing Boolean operations.

4 What is Finite Element Analysis (FEA)? Explain the basic steps.

5 Explain the Product Development Cycle and the Product Life Cycle. Illustrate the stages of each cycle using diagrams and discuss their importance in engineering and marketing.

6 Value Engineering and Lean Manufacturing: A company manufactures a mechanical assembly containing 15 components, although only 10 components are essential for performing the required functions. The product has high manufacturing cost and excessive assembly time. Analyze the product using value engineering and lean manufacturing principles: (a) Explain the concept of value engineering and its relationship with product function. (2 Marks) (b) Identify how unnecessary components can increase manufacturing and assembly costs. (2 Marks) (c) Apply value-engineering principles to suggest methods for reducing product cost without reducing essential functions. (2 Marks) (d) Explain suitable lean manufacturing techniques for reducing waste in the production system. (2 Marks) (e) Evaluate the expected benefits of applying value engineering and lean manufacturing together. (2 Marks)