Temperature in Metal Cutting: Heat generation in metal cutting; temperature distribution in metal cutting, effect of cutting speed on temperatures, measurement of cutting temperatures
Tool life and tool Wear: progressive tool wear; forms of wear in metal cutting: crater wear, flank wear, tool-life criteria,
cutting tool materials: basic requirements of tool materials, major classes of tool materials: high-speed steel, cemented carbide, ceramics, CBN and diamond, tool coatings; the work material and its machinability
Cutting fluids: Action of coolants and application of cutting fluids.

Unit 4: Processing of Powder Metals
Introduction; Production of Metal Powders: Methods of Powder Production, Particle Size, Shape, and Distribution, Blending Metal Powders; Compaction of Metal Powders: Equipment,Isostatic Pressing, Sintering; Secondary and Finishing Operations; Design Considerations.

Unit 5: Processing of Ceramics and Glasses
Introduction; Shaping Ceramics: Casting, Plastic Forming, Pressing, Drying and Firing, Finishing Operations; Forming and Shaping of Glass: Flat-sheet and Plate Glass, Tubing and Rods, Discrete Glass Products, Glass Fibers; Techniques for Strengthening and Annealing Glass: Finishing Operations; Design Considerations for Ceramics and Glasses

Unit 6: Processing of Plastics
Introduction; Extrusion: Miscellaneous Extrusion Processes, Production of Polymer Reinforcing Fibers; Injection Moulding: Reaction-injection Molding; Blow Moulding; Rotational Moulding; Thermoforming; Compression Moulding; Transfer Moulding; Casting; Foam Moulding; Cold Forming and Solid-phase Forming; Processing Elastomers

Texts:

1. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 6th edition, 2009.
2. Geoffrey Boothroyd, Winston Knight, "Fundamentals of Machining and Machine Tools", Taylor and Francis, 3rd edition, 2006.

References:

1. Milkell P. Groover, " Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons, New Jersey, 4th edition, 2010.
2. Paul De Garmo, J. T. Black, Ronald A. Kohser, " Materials and Processes in Manufacturing", Wiley, 10th edition, 2007.
3. M. C. Shaw, "Theory of Metal Cutting", Oxford and I.B.H. Publishing, 1st edition, 1994.

Machine Design - II

BTMEC602	PCC 23	Machine Design - II	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

9/6/2022
(Dr. M.V. Wandhekar)

Course Outcomes: At the end of the course, students will be able to:

CO1	Define function of bearing and classify bearings.
CO2	Understanding failure of bearing and their influence on its selection.
CO3	Classify the friction clutches and brakes and decide the torque capacity and friction disk parameter.
CO4	Select materials and configuration for machine element like gears, belts and chain
CO5	Design of elements like gears, belts and chain for given power rating
CO6	Design thickness of pressure vessel using thick and thin criteria

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1						1				1
CO2	3	2		1		1		1		1		1
CO3	1	1				1		1		1		1
CO4	3	3	2	1		2		1		1		1
CO5	1	1				1		1		1		1
CO6	3	2	2	1		1		1		1		1

Course Contents:

Unit 1: Rolling Contact Bearings

Types, Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent load, load and life relationship, selection of bearing life, Load factor, selection of bearing from manufacturer's catalogue, Taper roller bearings and their selection, Cyclic loads and speeds, Design for probability of survival other than 90% Lubrication and mountings of rolling contact bearings.

Sliding Contact Bearings: Methods of lubrication, Viscosity and its measurement, Effect of temperature, viscous flow through rectangular slot, Hydrostatic step bearing, Load capacity and energy losses, Reynolds equation, Raimondi and Boyd method, temperature rise, Constructional details of bearing, Bearing material, Lubrication oils, Additives and greases, Sintered metal bearings, Comparison of rolling and sliding contact bearings.

Unit 2: Spur Gear

Gear drives, Classification of gears, Law of gearing, Terminology of spur gear, Standard system of gear tooth force analysis, gear tooth failures, Selection of materials Constructional, Number of teeth, Face with, Beam strength equation, Effective load on gear tooth, Estimation of module based on beam strength.

Design for maximum power capacity, Lubrication of gears.

Helical Gears: Terminology, Virtual number of teeth, Tooth proportions, Force analysis, Beam strength equation, Effective load on gear tooth, Wear strength equation.

Unit 3: Bevel Gears

Types of bevel gears, Terminology of straight bevel, force analysis, Beam and Wear strength, Effective load on gear tooth.

Worm Gears: Terminology, Proportions, Force analysis, Friction in worm gears, Vector

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method, Selection of materials, Strength and wear rating, Thermal considerations

Unit 4: Belt and Chain Drives
Flat and V belts, Geometric relationship, analysis of belt tensions, condition for maximum power, Selection of flat and V belts from manufacturer's catalogue, Adjustment of belt tensions. Roller chains, Geometric relationship, polygonal effect, power rating of roller chain, sprocket wheels, and Silent chains.
Flywheel: Introduction, types of flywheel, stresses in disc and armed flywheel.

Unit 5: Brakes and Clutches
Types of clutches, torque capacity, single and multi-plate clutches, cone clutch, centrifugal clutch, friction materials.
Types of brakes, energy equation, block with shoe brake, pivoted brake with long shoe, internal expanding shoe brake, thermal considerations.

Unit 6: Pressure Vessel
Thin cylinders, thick cylinders, principal stresses, Lame's equation, Clavirino and Birnie's equation, cylinder with external pressure, autofrettage, compounding of cylinders, gasketed joint, unfired pressure vessel, thickness of cylindrical and spherical pressure shells, end closure, opening in pressure vessel, area compensation method

Texts:

1. V. B. Bhandari, "Design of machine Elements", Tata McGraw Hill Publications, New Delhi, 1998
2. R. L. Nortan, "Machine Design: An Integrated Approach", Pearson Education.

References:

1. J. E. Shigley, C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Inc, New York, 6th edition, 2003.
2. R. C. Juvinall, K. M. Marshek, "Fundamentals of Machine Component Design", John Wiley & Sons, Inc, New York, 2002.

Applied Thermodynamics – II

BTMEC603	PCC 24	Applied Thermodynamics – II	2-1-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Thermodynamics, Applied Thermodynamics - I

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

9/6/2021
Dr. H. M. Mahadeva

Dr. Babasaheb Ambedkar Technological University, Lonere

Semester Examination (6th June 2019)

VI Semester B. Tech. (Mechanical)

Subject: Machine Design – II

Max. Marks: 70 **Max. Time: 3 hrs.**

INSTRUCTIONS: 1. **Question No. 1 is compulsory**. Attempt any **FIVE** questions **out of the remaining** preferably in the order they are appearing.
2. Necessary data is given in the respective questions. If such a data is not given, it means that the knowledge of the data is a part of the examination.
3. Make suitable assumptions if necessary and state them clearly giving reasons.

Que.1: Choose the **appropriate answer** for the followings: (10)

A) Criteria for failure of machine parts subjected to fluctuating stresses is ----

i) ultimate tensile strength ii) yield strength

iii) endurance strength iv) modulus of elasticity

B) Number of cycles of repetitions for low cycle fatigue---

i) between 10^3 to 10^6 ii)less than 10^3

iii) more than 10^6 iv) between 10^2 to 10^4

C) It is necessary to use pump in bearing of .....

i) hydrodynamic type ii) hydrostatic type iii) radial type iv) thrust type

D) The length to diameter ratio for a square bearing is ...

i) less than 1 ii) more than 1 iii) ∞ iv) 1

E) The bearing No. XX10 indicate that the bearing is having ..

i) bore diameter of 10 mm ii) bore diameter of 100 mm

iii) bore diameter of 50 mm iv) outer diameter of 100 mm

F) The product of diametral pitch 'P' and circular pitch 'p' is ----

i) π ii) $1/\pi$ iii) $\pi/2$ iv) 1

G) When the axes of the two shafts are parallel, use -----

i) crossed helical gear s ii) bevel gears

iii) worm gears iv) spur and helical gears

H) Compared with spur gears, Helical gears ---

i) runs more smoothly ii) runs with noise and vibration

iii) consumes less powers iv) runs exactly alike

I) Which is incorrect relationship for gears?

i) circular pitch x diametral pitch = π ii) module = (PCD/No. of teeths)

iii) dedendum = 1.157 x module iv) addendum = 2.157 x module

J)) Power transmitted in belt drive depends on the ...

i) rpm ii) T_1 and T_2 iii) arc of contact iv) all of these

Que.2: A) Attempt **any two** of the following

i) What is stress concentration? What is stress concentration factor? What are the causes of stress concentration factor? (03)

ii) What is low cycle fatigue? Give practical example of low cycle fatigue? (03)

iii) What are the factors that affect endurance limit of machine part? (03)

B) A transmission shaft of cold drawn steel 27Mn2 (S_{ut} = 500 N/mm^2 and S_{yt} = 300 N/mm^2) is subjected to a fluctuating torque, which varies from -100 N. m to + 400 N. m. The factor of safety is 2 and the expected reliability is 90%. Neglecting the effect of stress concentration, determine the diameter of the shaft. Assume distortion energy theory of failure.

Data: K_a =0.89, K_b = 0.85 and K_c = 0.897 (06)

Que.3:

A) What is equivalent dynamic load in rolling contact bearings? (03)

B) Define static and dynamic load carrying capacity of the roller bearing. (03)

C) A ball bearing operates on the following work cycle

Element No.	Radial Load (N)	Speed (rpm)	Element Time (%)
1	3000	720	30
2	7000	1440	50
3	5000	900	20

The dynamic load capacity of the bearing is 16.6 kN. Calculate,

i. The average speed of rotation. ii. The equivalent radial load

iii. The bearing life. (06)

Que.4: Attempt **ANY TWO** of the followings.

A) Derive the fundamental equation for viscous flow through the rectangular slot.

$$Q = \Delta p b h^3 / 12 \mu l$$

C) A pair of parallel helical gears consists of 20 teeth pinion meshing with a 40 teeth gear. The helix angle is 25^0 and the normal pressure angle is 20^0. The normal module is 3 mm. Calculate ;

i) the transverse module

ii) the transverse pressure angle

iii) the axial pitch

iv) the pitch circle diameters of the pinion and gear

v) center distance

vi) the addendum and dedendum circle diameters of the pinion (06)

Que.7: Attempt **ANY TWO** of the following

A) What are advantages of leather belts over fabric belts? What do you understand by term ply of belts? Why slip is less in V belts compared to flat belts? (06)

B) Discuss the construction of roller chain with the help of suitable sketch. (06)

C) What is the polygonal action in roller chain? How will you reduce it? (06)

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where 'Δp' is pressure difference between two sides, 'l' is length of slot in the direction of flow, 'b' and 'h' are dimensions of the slot in the direction perpendicular to the direction of flow, μ is absolute viscosity of the lubricating oil. (06)

B) Why hydrostatic bearing is called externally pressurized bearing. Give its two applications. State any two advantages of hydrostatic bearing over hydrodynamic bearings. (06)

C) Following data is given for hydrostatic thrust bearing.

Speed = 720 rpm, Shaft diameter = 400 mm

Recess diameter = 250 mm Film thickness = 0.15 mm

Viscosity of lubricant = 30 cP Specific gravity = 0.86

Specific heat = 1.75 kJ/kg^{0}C supply pressure = 5 MPa

Calculate i) load carrying capacity of the bearing ii) pumping power loss iii) frictional power loss. (06)

Que. 5:

A) Answer the followings.

i) What is dynamic load on gear tooth? What are its causes? (02)

ii) What are advantages of 20^0 full depth involute teeth gears? (02)

iii) Why permissible bending stress for gear tooth is taken as one third of ultimate tensile stress? (02)

B) A pair of spur gears consists of a 24 teeth pinion, rotating at 1000 rpm and transmitting power to a 48 teeth gear. The module is 6 mm, while the face width is 60 mm. Both gears are made of steel with an ultimate tensile strength of 450 N/mm^2. They are heat treated to surface hardness 250 BHN. Assume that velocity factor accounts for the dynamic load. Calculate,

i) Beam strength ii) Wear strength iii) The rated power that the gears can transmit, if service factors and factor of Safety are1.5 and 2 respectively. (06)

DATA: Lewis form factor Y= 0.337

Que.6:

A) Show minimum face width for helical gear, $b \geq \frac{\pi m_n}{Sin\psi}$ (03)

B) What is virtual number of teeth in helical gear? What is relationship between actual and virtual number of teeth and helix angle? (03)

Dr. Babasaheb Ambedkar Technological University, Lonere

Semester Examination (May 2017)
VI Semester B. Tech. (Mechanical)
Subject: Machine Design – II

Max. Marks: 70 **Max. Time: 3 hrs.**

INSTRUCTIONS: 1. **Que.1 is COMPULSORY**. Attempt any **FIVE** questions **out of the remaining** preferably in the order they are appearing.
2. Necessary data is given in the respective questions. If such a data is not given, it means that the knowledge of the data is a part of the examination.
3. Make suitable assumptions if necessary and state them clearly giving reasons.

Que.1: Choose the **appropriate answer** for the followings: (10)

A) The stress which vary from a minimum value to maximum value of the same nature (i.e. tensile or compressive) is called
1) repeated stress 2) yield stress
3) alternating stress 4) fluctuating stress

B) Maximum stress concentration factor for a rectangular plate with a transverse hole loaded in tension and compression is ..
1) 2 2) 3 3) 2.5 4) 1

C) If the dynamic load carrying capacity of a ball bearing is increased 2 times without a change in equivalent dynamic load, the life of bearing increased by..
1) 600% 2) 800% 3) 700% 4) 400%

D) A ball bearing sustain a radial load of 3672 N. the diameter of the bearing is 60 mm and its length is 90 mm. Diametral clearance is 0.1 mm and shaft rotates at 450 rpm. If oil viscosity is 0.06 kg/m-s then, the value of Sommerfeld no. is..
1) 17×10^6 2) 14.3×10^6 3) 15.3×10^6 4) 16.3×10^6

E) The length to diameter ratio of a square bearing is..
1) more than 1 2) less than 1 3) ∞ 4) 1

F) In case of spur gear, increasing pressure angle results in…
1) weaker teeth 2) bigger size of gear
3) higher pitch line velocity 4) wider base and stronger teeth

G) Wear strength of gear can be improved by
1) Increasing BHN 2) increasing endurance limit
3) increasing S_{yt} 4) increasing compressive strength

H) When belt speed increases
1) power transmitting increases 2) power transmitting decreases
3) power transmitting increases to a maximum value then decrease
4) power transmitted remain same

I) Creep in belt is due to ...
1) effect of temperature on belt
2) material of belt
3) unequal extensions of belt
4) stresses beyond elastic limit in belt material

J) Main type of failure in roller chain are..
1) breakage of link plates
2) wear of rollers and pins
3) wear of sprocket wheels
4) all of the above

Que.2: A) Discuss in detail the factors which affects the endurance limit of machine part. (06)

B) A solid circular shaft, made of Fe620 (S_{ut} = 620 N/mm^2 and S_{yt} = 380 N/mm^2) is subjected to an alternating torsional moment, which varies from -200 N. m to + 400 N. m, the shaft is ground and expected reliability is 90%. Neglecting stress concentration, Calculate the shaft diameter for infinite life. The factor of safety is 2. Use distortion energy theory of failure.

Data: K_a =0.89, K_b = 0.85 and K_c = 0.897 (06)

Que 3: A) What is equivalent dynamic load in rolling contact bearings? (02)

B) A ball bearing operates on the following work cycle

Element No.	Radial Load (N)	Speed (rpm)	Element Time (%)
1	3000	720	30
2	7000	1440	50
3	5000	900	20

The dynamic load capacity of the bearing is 16.6 kN. Calculate,
1. The average speed of rotation.
2. The equivalent radial load
3. The bearing life. (05)

C) A ball bearing subjected to radial load of 5 kN, is expected to have a life of 8000 hr at 1450 rpm with a reliability of 99%. Calculate the dynamic load capacity of the bearing, so that it can be selected from the manufacturer's catalogue based on reliability of 90%. (05)

Que.4: A) Derive the equation for thrust load carrying capacity of hydrostatic step bearing

$$W = \frac{\pi P_i}{2}\left[\frac{R_o^2 - R_i^2}{\log_e\left(\frac{R_o}{R_i}\right)}\right]$$

, the notation carries usual meanings. (06)

B) The hydrostatic thrust bearing of a generator consist of six pads as shown in Figure-1(a). The total thrust load of 900 kN and the film thickness is 0.05. The viscosity of the lubricant is 300 SUS. Neglecting the flow over corners, each pad can be approximated as a circular area of R_0 and R_i as outer and inner radii respectively. This is shown in figure-1 (b). The ratio (R_i/R_0) is 0.2 and average bearing pressure is 0.8 MPa. The density of the lubricating oil is 0.9 gm /cc. Calculate:

i) outer and inner radius of each pad ii) supply pressure iii) flow requirement (06)

Que. 5: A) Why permissible bending stress for gear tooth is taken as one third of ultimate tensile stress? (02)

B) When pinion and gear are made of different materials, which component is to be designed? Why? (02)

C) A pair of spur gears consists of a 24 teeth pinion, rotating at 1000 rpm and transmitting power to a 48 teeth gear. The module is 6 mm, while the face width is 60 mm. Both gears are made of steel with an ultimate tensile strength of 450 N/mm^2. They are heat treated to surface hardness 250 BHN. Assume that velocity factor accounts for the dynamic load. Calculate,

a) Beam strength

b) Wear strength

c) The rated power that the gears can transmit, if service factors and factor of Safety are1.5 and 2 respectively.

DATA

The error for grade 8 is given by $e = 16 + 1.25\,(m + 0.25\sqrt{d}\,)$

Lewis form factor is given as below

No teeth	18	20	22	24	25	26	27	28	29	30	32	33	35
Y	0.308	0.32	0.33	0.337	0.34	0.344	0.348	0.352	0.355	0.358	0.364	0.367	0.373

(08)

Que.6: A) A pair of parallel helical gear consist of 18 teeth meshing with a 45 teeth gear. A 7.5 kW power at 2000 rpm is supplied to pinion through its shaft. The normal module is 6 mm and normal pressure angle is 20^0. The pinion has right hand teeth while the gear has left hand teeth. The helix angle is 23^0. The pinion rotates in the clockwise direction

when seen from the left side. Determine the component of tooth force and draw free body diagram showing the forces acting on pinion and gear. (06)

B) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20^0, while the helix angle is 25^0. The face width of the gear is 40 mm and the normal module is 4 mm. The pinion as well as gear are made up of 40C8 (S_{ut} = 600 N/mm^2) and heat treated to surface hardness of 300 BHN. The service factor and factor of safety are 1.5 and 2 respectively. Assume velocity factor to account for dynamic load calculate power transmitting capacity of the gear. (Refer Lewis form factor data from Que.5) (06)

Que.7: A) It is required to select a flat belt drive for a fan running at 360 rpm which is driven by 10 kW, 1440 rpm motor. The belt drive is open type and space available for a centre distance of 2 m approximately. The belt velocity should be between 17.8 to 21.9 m/s. the power transmitting capacity of belt per mm width ply at 180^0 arc of contact and at belt velocity of 5.08 m/sec is 0.0118 kW. The load correction factor can be taken as 1.2. Suggest preferred diameter of motor and fan pulleys and give completion specification of belting. (06)

B) a simple chain No.10B is used to transmit power from a 1400 rpm electric motor to a line shaft running at 350 rpm. the number of teeth on the driving sprocket is 19 . the operation is smooth without shock. Calculate:

1. the rated power for which the chain drive can be recommended;
2. the tension in the chain for this rated power and;
3. the factor of safety for the chain based on the braking load.

Service factor k_s =1, strand factor k_1=1, tooth correction factor = K_2 =1.11, power rating for chain at 1440 rpm = 11.67 kW. (06)

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