



Name: ..... Roll No.: .....

Branch: ..... Signature of Invigilator: .....

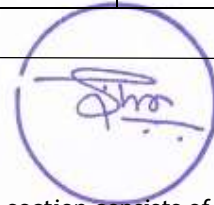
Semester: IVth

Date: 02/05/2022 (MORNING)

Subject with Code: ME211 MACHINE DESIGN

Marks Obtained	Section A (30)	Section B (20)	Total Marks (50)

INSTRUCTION TO CANDIDATE



1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.
2. The booklet will be distributed to the candidates before 05 minutes of the examination. Candidates should write their roll no. in each page of the booklet.
3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.
4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.
5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.
6. Write on both side of the leaf and use pens with same ink.
7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.
8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.
9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.
10. Always maintain the highest level of integrity. Remember you are a BITian.
11. Candidates need to submit the question paper cum answer sheets before leaving the examination hall.

INSTRUCTIONS:

1. Attempt all questions.
  2. Students should write full correct option against the multiple-choice questions.
  3. Write answer neatly on a plain paper with proper answer label corresponding to each question.
  4. The missing data, if any, may be assumed suitably.
  5. **Machine Design Data hand book to be supplied to the candidates in the examination hall.**
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Q.1 Consider the following statements.

[2 marks]

- (a) Endurance limit of a beam subjected to pure bending decreases with increase in the surface roughness and increase in the size of the beam.
- (b) 18/8 stainless steel has 18% chromium and 8% nickel.
- (c) Resilience is the capacity of a material to absorb energy when it is deformed permanently and then, recovering same upon unloading.
- (d) For completely reversed loading condition, the strength criteria using Goodman, Soderberg and Gerber equations will give same result.
- (e) The factor of safety is independent of uncertainties in the magnitude of forces acting on the component.

Which of the above statements are TRUE?

- (b), (c), and (e)
- (a), (b), (c), and (e)
- (b), (c), and (d)
- (a), (b), and (d)
- (a), (b), (d) and (e)

Q.2 Fatigue life of a material for a fully reversed loading condition is estimated from  $\sigma_a = 1100N^{-0.15}$ , where  $\sigma_a$  is the stress amplitude in MPa and  $N$  is the failure life in cycles. The maximum allowable stress amplitude (in MPa) for a life of  $10^5$  cycles under the same loading condition is approximately

[2 marks]

- 116 MPa
- 156 MPa
- 196 MPa
- 300 MPa

Q.3 Can the cotter joint be used to connect slide spindle and fork of valve mechanism?

[2 marks]

- True
- False

Q.4 Which of the following methods can increase shock absorbing capacity of bolts?

[2 marks]

1. Reduce the shank diameter to core diameter of threads.
2. Increase the length of shank portion of bolt.

- Only 1
- Only 2
- Both 1 and 2
- Neither 1 nor 2

**Q.5** A 60 mm long and 6 mm thick fillet weld carries a steady load of 15 kN along the weld. The shear strength of the weld material is 200 MPa. The factor of safety is **[2 marks]**

- 1.4
- 2.4
- 3.4
- 4.4

**Q.6** Consider the following statements. **[2 marks]**

- (a) Caulking and fullering processes are used to obtain leakproof riveted joints.
- (b) Square threads are used for transmission of power in either direction.
- (c) The parallel and transverse fillet welded joints are designed for tensile strength and shear strength, respectively.
- (d) A stud is fully threaded and has no head.
- (e) Fine threads have greater resistance to unscrewing because of lower helix angle.

Which of the above statements are true?

- (a), (b), (c), (d), and (e)
- (a), (b), (c) and (d)
- (a), (c), (d) and (e)
- (a), (b), (d), and (e)

**Q.7** A brake commonly used in railway trains is **[2 marks]**

- Shoe brake
- Band brake
- Band and block brake
- Internal expanding brake

**Q.8** Which of the following statement is false? **[2 mark]**

- The uniform-pressure theory is applicable only when the friction lining is new.
- It is more logical and safer to use uniform wear theory in the design of clutches.
- The uniform-wear theory is applicable when the friction lining gets worn out.
- The uniform-pressure theory is applicable when the friction lining gets worn out.
- The torque transmitting capacity of new clutches is slightly more than that of worn-out clutches.

**Q.9** Following brake can never become self-locking **[2 mark]**

- Block brake
- Band brake
- Disk brake
- None of the above

**Q.10** Which of the following statement is FALSE? **[2 marks]**

- Helical tension spring is used to measure weights in spring balance.
- Needle roller bearing is preferred for oscillating load conditions.
- In a single row deep groove ball-bearing, cages are needed to ensure that the balls do not cluster at one point and maintain proper relative angular positions.
- Journal bearings are referred as antifriction bearings.
- Babbit's most widely used bearing materials are tin-based and lead-based.
- Cylindrical roller bearing should not be subjected to thrust load.

**Q.11** A journal bearing of 60 mm diameter is subjected to a radial load of 25 kN. The shaft supported on the bearing is rotating at 1400 rpm. If the coefficient of friction is **0.003**, the heat generated is **[2 marks]**

- 154 W
- 330 W
- 298 W
- 430 W

**Q.12** If the wire diameter of a compressive helical spring is increased by 2%, the change in stiffness (in %) is approximately **[2 marks]**

- 5
- 8
- 17
- 10

**Q.13** Match the type of gears with their most appropriate description. **[2 marks]**

Type of gear	Description
P. Helical	1. Axes non-parallel and non-intersecting
Q. Spiral Bevel	2. Axes parallel and teeth are inclined to the axis
R. Hypoid	3. Axes are parallel, and teeth are parallel to the axis
S. Rack and pinion	4. Axes are perpendicular and intersecting, and teeth are inclined to the axis
	5. Axes are perpendicular and used for large speed reduction
	6. Axes parallel and one of the gears has infinite radius

Choose the correct option from below:

- P – 2, Q – 5, R – 3, S – 6
- P – 3, Q – 4, R – 1, S – 6
- P – 2, Q – 1, R – 3, S – 5
- P – 2, Q – 4, R – 1, S – 6

**Q.14** Which of the following is/are the methods to prevent the interference in gears? **[2 marks]**

- (a) Stubbing the gear teeth
- (b) Undercutting the gears
- (c) Decreasing the pressure angle
- (d) Increasing number of teeth

Choose the correct option from below

- (a), (b), (c) and (d)
- (a), (b), and (c)
- (a), (b), and (d)
- (b) and (d)

**Q.15** Which of the following statement is FALSE? **[2 marks]**

- When the same material is used for pinion and gear, the beam strength of pinion is less than that of gear.
- The Lewis form factor is always less for gear as compared to pinion.
- Involute gear profile is made of single curve, while cycloidal gear profile is made of two curves.
- As per the Law of gearing, the common normal at the point of contact between a pair of teeth must always pass-through pitch point.
- Gear contact ratio is the ratio of the length of the arc of contact to the circular pitch.

**Q.16** A work cycle of a mechanical element is subjected to complete reversed bending stresses as follows:

- (a)  $\pm 300$  MPa for 30 % of time
- (b)  $\pm 275$  MPa for 25 % of time
- (c)  $\pm 400$  MPa for 10 % of time
- (d)  $\pm 325$  MPa for 25 % of time
- (e) No load for remaining time

The material has an ultimate tensile strength of 1200 MPa. Take surface finish factor as 0.8, size factor as 0.85, reliability factor as 0.897 for 90 % reliability. The operating temperature is 400° C and the temperature factor may be taken as 0.5. Assume the fatigue stress factor at the most stressed section as 0.7. Determine the life of the component. **[5 marks]**

**Q.17** A double riveted double strap butt joint is made in 12 mm thick plates with 16 mm diameter rivets. Find the efficiency of the joint for a pitch of 48 mm, if the permissible stresses in tension, compression and shear are 80 MPa, 120 MPa and 60 MPa respectively. **[5 marks]**

**Q.18** What is the difference between the clutch and the brake? Also name the different types of clutches. Give at least one practical application of each. **[5 marks]**

**Q.19** It is required to design a spur gear speed reducer for a compressor running at 250 rpm driven by a 7.5 kW, 1000 rpm electric motor. The centre distance between the axes of the gear shafts should be exactly 250 mm. The starting torque of the motor can be assumed to be 150% of the rated torque. The gears are made of carbon steel 50C4 ( $S_{ut} = 700$  N/mm<sup>2</sup>). The pressure angle is 20°. The factor of safety is 2 for preliminary design based on the use of velocity factor.

(i) Assume that the gears are manufactured to meet the requirements of Grade 6 and calculate the dynamic load by using Buckingham's equation. **[5 marks]**

:::::02/05/2022:::::



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