Total No. of Questions: 24

Enrollment No : _____

MEDICAPS UNIVERSITY

Faculty of Engineering

End Semester Examination May 2025

CE3CO31 Design of steel Structures

Programme	:	B.Tech.	**Branch/Specialisation**	:	CE
Duration	:	3 hours	**Maximum Marks**	:	60

Note: *All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary. Notations and symbols have their usual meaning.*

Section 1 (Answer all question(s))

Marks CO BL

Q1. ISHB Stands for_____. **1 1 2**

- ○ Indian Standard Heighted Beam
- ◉ Indian Standard Heavy Beam
- ○ Indian Standard Heavy weighted Bridge
- ○ None of these

Q2. In a structure which has vibration due to loading, which type of connections are generally used? Choose the right option **1 1 2**

- ○ Bolted connection
- ○ Welded connection
- ○ Double cover bolted connection
- ◉ Riveted connection

Q3. The problem of web crippling in beams is significant when- **1 1 2**

- ◉ Web is weak under concentrated loads
- ○ There is too much flexural moment
- ○ Compression flange is weak
- ○ None of these

Q4. Economical depth of plate girder corresponding to- **1 1 2**

- ◉ Minimum weight
- ○ Minimum moment
- ○ Minimum crippling
- ○ Maximum weight

Q5. Strut is a _____. **1 1 2**

- ○ Tension member
- ◉ Compression member
- ○ Tie
- ○ None of these

Q6. The block shear failure of tension member involves failure planes which have- **1 1 2**

- ○ Two mutually perpendicular tension planes
- ○ Two mutually perpendicular shear plane
- ◉ Tension on one plane and shear on other perpendicular plane
- ○ Tension on one plane and compression on another perpendicular plane

Q7. In the plastic method of base plate designing the pressure from the concrete below is assumed to be equal to- **1 1 2**

- ○ 0.55 fck
- ◉ 0.45 fck
- ○ 0.6 fck
- ○ 0.65 fck

Q8. Splice plates in columns are designed as- **1 1 2**

- ◉ Short column
- ○ Intermediate column
- ○ Long column
- ○ None of these

Q9. The maximum slenderness ratio limit for truss members under loads other than wind / earthquake load is- **1 1 2**

- ◉ 180
- ○ 80
- ○ 200
- ○ 220

Q10. In general, purlins are designed as- **1 1 2**

- (•) Continuous beams
- ( ) Simply supported beams
- ( ) Cantilever beams
- ( ) None of these

Section 2 (Answer all question(s))

Marks CO BL

Q11. Specify different structural steel sections with details. **2 2 1**

Rubric	Marks
Structural steel sections. Four types 0.5 mark for each	2

Q12. Differentiate between welded, bolted and riveted joints. **3 1 2**

Rubric	Marks
Compare b/w welded and bolted / riveted joints. Three points 1 mark for each	3

Q13. (a) Two plates of thickness 16 mm and 14 mm are required to be joined by butt weld. The plates are subjected to a factored tensile load of 400 kN. The effective weld length is limited to 180 mm. Calculate that which type of weld out of single / double v butt weld is to be provided. **5 2 3**

Rubric	Marks
For single v butt weld For calculation of effective throat thickness	1
Strength of weld (315 kN)	1.5
For double v butt weld	1
For calculation of effective throat thickness 1 mark Strength of weld (504 kN)	1.5

(OR)

(b) Two plates 10 mm x 60 mm are connected in a lap joint with 5 number of M16 bolts (arranged longitudinally in linear pattern) of grade 4.6 and 410 grade plates. calculate the strength of joint.

Rubric	Marks
For design shear strength of one bolt (29.72kN)	1
For design bearing strength of one bolt (64.28kN)	2
For design tensile strength of plate in yielding (136.36kN)	1
For design tensile strength of plate in rapture (123.98kN) and reporting this as answer	1

Section 3 (Answer all question(s))

Marks CO BL

Q14. Define plastic section modulus. **2 1 2**

Rubric	Marks
Definition plastic section modulus.	2

Q15. Explain lateral stability of beams. What are the mechanisms through which it is ensured? **3 2 3**

Rubric	Marks
Lateral stability of beams	1.5
Mechanisms through which it is ensured	1.5

Q16. (a) A simply supported steel beam of 5 M span has to support a load of 60 kN/meter (inclusive of self wt.).The beam compression flange is restrained against buckling. Design beam section using ISWB section and Fe 410 steel grade for flexure. **5 4 5**

Rubric	Marks
Calculation of factored udl (90kN)	1
Calculation of factored BM (281.25kNm)	1
Calculation of factored SF (225kN)	1
Calculation of plastic section modulus (1237x106mm3)	1
Recommending ISWB400 (654 N/m)	1

(OR)

(b) Design a laterally supported beam of effective span 6m for the following data-
Grade of steel : Fe 410
Maximum bending moment: 150 kNm
Maximum shear force V = 210 kN
Check for deflection not required

Rubric	Marks
Plastic section modulus: 660 x 10^3 mm^3	1
Check for shear capacity $V>0.6V_d$	1
Bending Strength	1
Check for web buckling	2

Section 4 (Answer all question(s))

Marks CO BL

Q17. How does area calculation in design of tension member is different than the area calculation in design of compression member? **2 1 2**

Rubric	Marks
Write explanation	2

Q18. What are the failure modes for tension members? **3 1 2**

Rubric	Marks
Each mode of failure 1 mark	3

Q19. (a) Illustrate the procedure for the design of tension member. **5 2 3**

Rubric	Marks
1 mark for each step	5

(OR)

(b) Write the procedure for the design of column.

Rubric	Marks
1 mark for each step	5

Section 5 (Answer all question(s))

Marks CO BL

Q20. How does compound column are different than beam? **2 1 2**

Rubric	Marks
Define	2

Q21. Explain following types of column bases through labelled diagrams- **3 2 2**
(a) Slab base (b) Gusseted base.

Rubric	Marks
Slab base	1.5
Gusseted base	1.5

Q22. (a) Determine the size and thickness of simple base plate type slab base for an ISHB 300 @ 618 N / m. Column to carry a factored load of 1000kN. Assume Fe 410 grade steel and M25 grade concrete. **5 3 4**

Rubric	Marks
Area of base plate (88.89 x 103 Sq mm)	1
Actual bearing pressure (7.15 N/mm2)	1
Thickness of base plate (11.75 mm)	2
Connection-required length of 8 mm fillet weld (1058 mm)	1

(OR)

(b) A column ISHB 350@ 661.2 N/m carries an axial compressive factored load of 1700 kN. Determine the thickness of base plate. The base rests on M15 grade concrete pedestal. Use 24 mm diameter bolts of grade 4.6 for making the connections.

Rubric	Marks
required area of base plate 251.85 x 10^3 mm^2 620 x 410 mm	1
Bearing pressure of concrete 6.68 N/mm^2	1
Maximum moment = 36125.44 Nmm	2
Thickness of plate	1

Section 6 (Answer all question(s))

Marks CO BL

Q23. What are different types of trusses? **4 1 2**

Rubric	Marks
Any four types of trusses 1 mark for each type	4

Q24. (a) Design basic purlin section for the truss for the following details- **6 4 5**

Span of purlins=6 m
Spacing of purlins =1.25 m
Angle of truss =11.3°
Live load =0.35 kN/m^2
Dead load =0.21 kN/m^2 including self-weight
Wind pressure =1.45 kN/m^2
Calculation for checks are ot required.

Rubric	Marks
Normal to slope 1.27 kN/m2 Parallel to slope 0.041 kN/M2	2
Load Wz= 0.7 kN/M, load Wy = 0.14 kN/M	1
Mz=3.78 kNm, My=0.756kNm Factored SF = 3.15 kN	2
Plastic section modulus required 16.632 x 103 mm3 and recommendation of section	1

(OR)

(b) Design a steel purlin for a roof truss with the following data-

Spacing of purlins = 1.5 m
Span of purlin = 5 m
Roof slope = 30°
Dead load (including self-weight) = 0.5 kN/m²
Live load = 0.75 kN/m²
Wind load (uplift) = 1.0 kN/m²
Use Z-section purlin of fy = 250 MPa

Rubric	Marks
Load Calculation: Total downward load per unit area: wd=0.5+0.75=1.25 kN/m² Load per meter length of purlin: Wd=1.25×1.5=1.875 kN/m Wind load per meter (uplift): Ww=1.0×1.5=1.5 kN/m	2
Bending Moment Calculation: For simply supported purlin, the maximum bending moment is: M=$wL^2/8$ M • For downward load: M_d=1.875×528=46.8758=5.86 kN\m • For wind uplift: M_w=1.5×528=37.58=4.69 kN\m • Net worst-case moment: M_{net}=5.86−4.69=1.17 kN\m (Since downward moment is larger, design for 5.86 kN·m)	2
Section Modulus Required: $Z_{req}=M_{fy}/\gamma_{m0Z}$ $Z_{req}=(5.86\times10^6)$ / $(250/1.15.86\times10^6)$ $Z_{req}=25.78\times10^3$ mm3	2

******