Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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V SEMESTER B.TECH. (CIVIL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: **ELEMENTS OF EARTHQUAKE ENGINEERING [CIE 3105]**

REVISED CREDIT SYSTEM
(05/12/2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Use of Code books, IS 13920:1993 & IS1893 (part-l)-2002 is allowed.
- Missing data may be suitable assumed.

1A.	Explain with the help of a neat diagram, the different types of seismic waves	**4**	**CO1**
1B.	For the SDOF system shown in fig. Q1, K_1=10 N/m, K_2= 20 N/m, K_3= 25N/m determine i) Natural frequency and time period in seconds ii) Value of damping coefficient, if the displacement amplitude reduces from 3mm at first cycle to 2.17 mm at second cycle.	**6**	**CO2**
2A.	The mass of SDOF system is subjected to dynamic forces of P0 Sin ωt. Allowing for viscous damping, obtain an expression for steady state vibration	**5**	**CO2**
2B.	The steel frame (each leg having, E = 200 kN/mm^2 & Ixx = 3x10^7 mm^4) shown in Fig.Q2, supports a rotating machine, which exerts a horizontal force at the girder level, F(t) = Sin (5.3 t) kN. Assuming 5% of critical damping determine, i) Steady-state amplitude of vibration ii) Maximum dynamic stresses in the column if the effective depth of the column is 180 mm. Assume the girder is rigid.	**5**	**CO2**
3A.	Explain the possible reasons for the following clauses mentioned in IS 13920-1993, i) Clause 6.1.2: The flexural member shall preferably have width- to-. depth ratio of more than 0.3 ii) Clause 6.2.2: The maximum steel ratio on any face at any flexural member section, shall not exceed ρmax = 0.025 iii) Clause 7.3.3: The spacing of hoops shall not exceed half the least lateral dimension of the column.	**3**	**CO3**
3B.	The Fig.Q3 shows reinforcement detail of a fixed beam of span 5 m. Check the adequacy of detailing of reinforcement as per IS 13920: 1993. Comment on all the checks that need to be done. Clear cover to reinforcement is 25 mm. Grade of concrete M25, Grade of steel Fe 415. Calculate the design shear force as per 6.3.3 (b). Moment of resistance of the beam section @ mid span = 137 kNm and @ end span = 162 kNm.	**7**	**CO3**

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4A.	A Five storied (G+4) RCC framed hospital building with live load of 3.5 kN/m^2 is to be constructed in Patna. The Fig.Q4 shows plan and elevation of the, structure. Work out seismic forces on the structure. All beams and columns may be assumed to be 300 mm x 500 mm and 400 x 500 mm respectively. The roof and floor slabs may be assumed to be 130 mm thick. The walls of 200 mm thick are present on all floor beams. The soil below the foundation is assumed to be medium soil. Draw seismic shear force diagram.	**10**	**CO3**
5A.	Explain with the help of neat diagrams, i) The concept of base isolation to reduce earthquake effects on buildings. ii) Short columns are more damaged during earthquake as compared to taller columns in the same story	**6**	**CO1**
5B.	Formulate the equation of motion from the basics in matrix form for the structure shown in Fig.Q5. Take (E I_1) = 350 kN-m^2 and (EI2) = 150 kN-m^2.	**4**	**CO3**

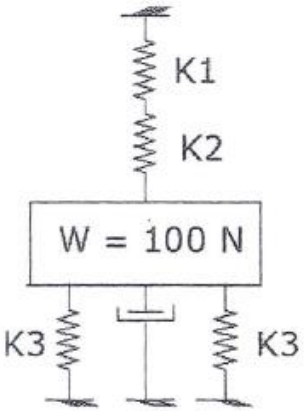


Fig.Q1

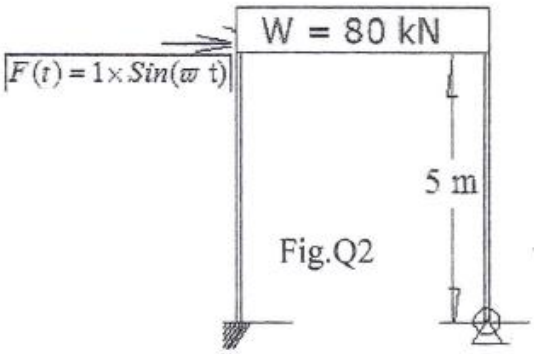


Fig.Q2

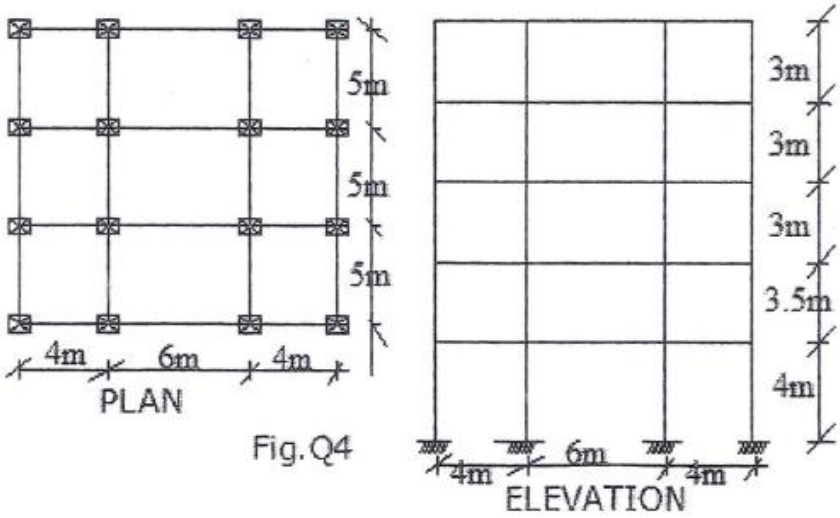
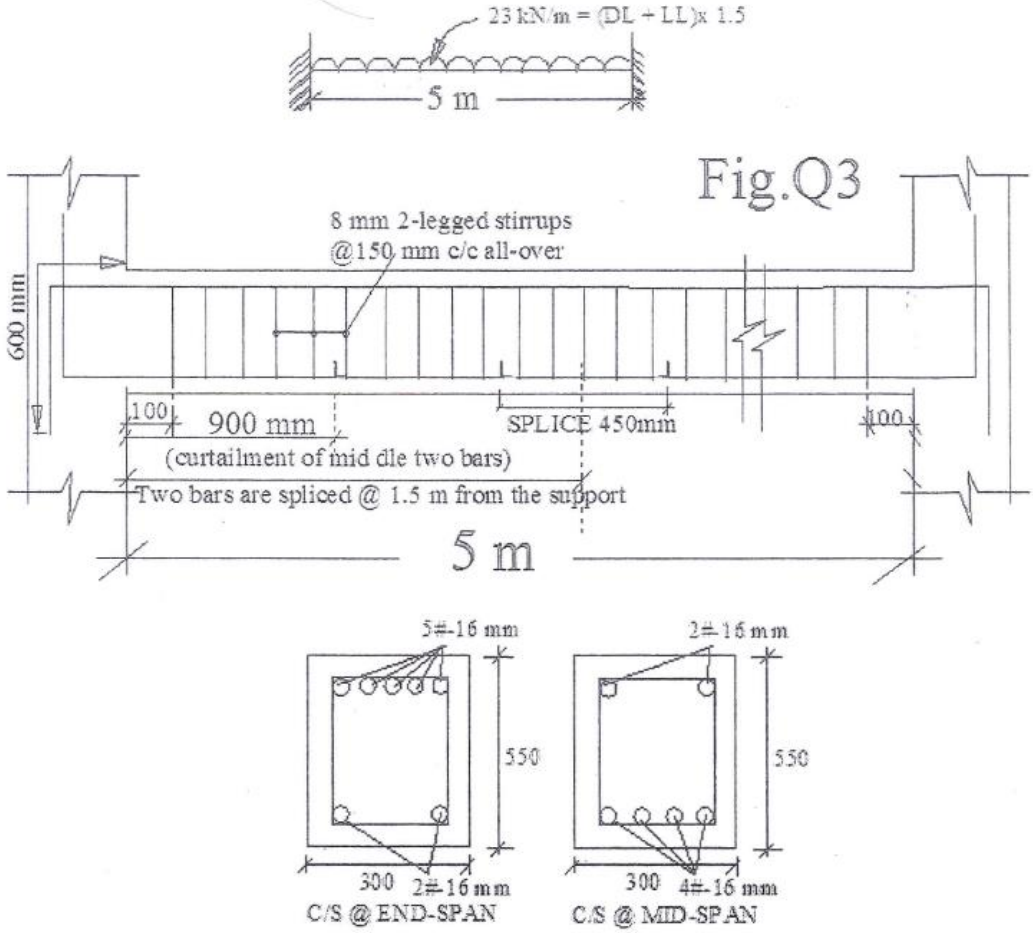


Fig.Q4


23 kN/m = (DL + LL)x 1.5
5 m
Fig.Q3
8 mm 2-legged stirrups
@150 mm c/c all-over
600 mm
100
900 mm
(curtailment of mid dle two bars)
SPLICE 450mm
100
Two bars are spliced @ 1.5 m from the support
5 m
5#-16 mm
550
300
2#-16 mm
C/S @ END-SPAN
2#-16 mm
550
300
4#-16 mm
C/S @ MID-SPAN

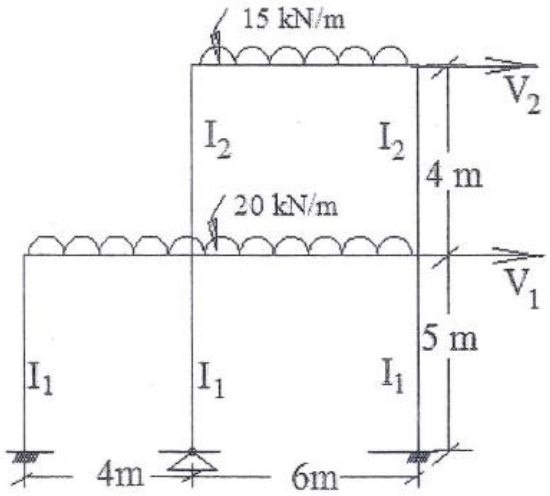

15 kN/m
V2
I2
I2
4 m
20 kN/m
V1
5 m
I1
I1
I1
4m
6m

Fig.Q5