**Duration: 3 hours**                                                    **Max. Marks: 80**

N.B.  (1) Question No. 1 is **COMPULSORY**.
       (2) Answer **ANY THREE** questions from Q.2 to Q.6.
       (3) Figures to right indicate full marks.

**Que. 1**  **a.**  Find Laplace Transform of $t\cos 4t . \cos 7t$                                    **5**

            **b.**  Find Fourier series expansion of $f(x) = x \ in \ (-\pi, \pi)$                      **5**

            **c.**  Find the orthogonal trajectory of the family of curves given by           **5**

                    $2x - x^3 + 3xy^2 = a$

            **d.**  If $A=\begin{bmatrix} -1 & 4 \\ 2 & 1 \end{bmatrix}$, Find eigen values of $A^3-3A^2+5A$    **5**

**Que. 2**  **a.**  Obtain Fourier series expansion for $f(x) = x^2 \ in \ (0, 2\pi)$                  **6**

            **b.**  By using partial fractions, find the inverse Laplace transform of        **6**
                    $\frac{s^2}{(s^2+9)(s^2+16)}$

            **c.**  Find the eigenvalues and the eigenvectors of the matrix                  **8**

                    $A=\begin{bmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{bmatrix}$

**Que. 3**  **a.**  Find the analytic function whose real part is $\dfrac{\sin 2x}{\cosh 2y + \cos 2x}$    **6**

            **b.**  Find the Laplace transform of $sinh^5 t$                                      **6**

            **c.**  Using Bender Schmidt method , solve $\frac{\partial^2 u}{\partial x^2} - \frac{\partial u}{\partial t} = 0$, subject to   **8**

                    $u(0,t) = 0, \ u(1,t) = 0, \ u(x,0) = \sin \pi x \quad 0 \leq x \leq 1$

**Que. 4**  **a.**  By using Laplace transform, evaluate, $\int_0^\infty \frac{\cos 3t - \cos 5t}{t} dt$     **6**

            **b.**  Find a , b ,c , d, e  if                                                    **6**
                    $f(z) = (ax^4 + bx^2 y^2 + cy^4 + +dx^2 - 2y^2) + i(4x^3 y - exy^3 + 4xy)$   is an
                    analytic function.

            **c.**  Obtain the half range cosine series of $f(x) = $                           **8**
                    $\begin{cases} x & 0 < x < \pi/2 \\ \pi - x & \frac{\pi}{2} < x < \pi \end{cases}$

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**Que. 5** **a.** Find the analytic function $f(z) = u + iv$, in terms of $z$, if $u = y^3 - 3x^2y$ **6**

**b.** If $L\{f(t)\} = \dfrac{s}{s^2 + s + 4}$, find $L\{e^{-2t} f(2t)\}$ **6**

**c.** Determine if the matrix A= $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ diagonalizable, hence **8**

find it's diagonal matrix D and modal matrix

**Que. 6** **a.** Determine the Half Range Sine Series for $f(x) = \dfrac{x(\pi^2 - x^2)}{12}$, where $0 < x < \pi$. **6**

**b.** Find inverse Laplace transform of $cot^{-1}\left(\dfrac{s+3}{2}\right)$ **6**

**c.** Using Crank- Nicholson simplified formula, solve $\dfrac{\partial^2 u}{\partial x^2} - \dfrac{\partial u}{\partial t} = 0$, **8**

$u(0, t) = 0$, $u(4, t) = 0$, $u(x, 0) = \dfrac{x}{3}(16 - x^2)$ for one step for time.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

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**(3 Hours)**                                  **Max Marks: 80**

**Note:** 1. Question No. **1** is compulsory.
2. Attempt any **3** out of five questions.
3. Assume any data suitably, if required.

**Q.1**      It is proposed to construct a Hospital Building in the suburb of Mumbai District. The building is G+1, R.C.C. framed structure on the plot size measuring 52 mt x 48 mt.

Following are the requirements:

- (i)      Entrance Lobby : min 4 mt wide
- (ii)      Hospital Admin Office : 25 sq mt
- (iii)      Doctor's Consulting Room 3 Nos ( 10 sq mt each)
- (iv)      Pathology Lab : 30 sq mt
- (v)      Radiology Lab : 30 sq. mt
- (vi)      Drug / Medicine Store: 20 sq. mt.
- (vii)      Operation Theatre : 30 sq. mt
- (viii)      Male Ward (6 Beds) : 50 sq. mt
- (ix)      Female Ward (6 Beds) : 50 sq.mt
- (x)      ICU  (3 Beds) : 30 sq.mt.
- (xi)      Doctor's rest room : 20 sq.mt
- (xii)      Canteen : 50 sq. mt
- (xiii)      Kitchen  : 20 sq. mt

Provide Sanitary Units, Circulation spaces, lift, staircase, parking etc as per bye laws.

Place the various requirements on Ground Floor and First Floor according to their function.

(i). Ground Floor Plan (Developed Plan)                  **15**
(ii). First Floor Plan (Line Plan)                         **05**

**Q.2**   **a**    Draw sectional elevation passing through staircase and other important units of the building which you have planned in Q.No.1      **15**

     **b**    Explain briefly Architectural composition.      **05**

**Q.3**   **a**    Draw Front Elevation for the building which you have planned in Q.No.1      **10**

     **b**    Explain Principle of Planning with neat sketches.      **10**

**Q.4**   **a**    Draw Two Point Perspective of the Hall measuring 8000 mm x 10000 mm having flat roof. Take Plinth Height 600 mm. Floor to Floor Height 3600. Parapet Height 1000 mm. Provide  Two Window (2000 x 1500) and One Door (1500 x 2100) on front wall. Assume any dimension suitably,  if required      **15**

     **b**    What are various types of Footing.      **05**

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**Q.5**   Design a dog-legged staircase for an educational building having floor to     **15**
floor height 3600 mm. Take height of Riser: 150 mm, Width of Tread: 300
mm.
Draw Plan and Section

**b**   Explain Use of Sun Path diagram in Planning of the Building.     **05**

**Q.6**   Write Short notes on any four:     **20**
        (a) Green Building
        (b) Types of Structures
        (c) Types of Doors
        (d) Application of software in Architecture & Civil Engineering
        (e) Objectives of Town Planning

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**(3) Hours**                                                                                    **Total Marks: 80**

**N.B.  1**.  Question No. **1** is **compulsory**
2.  Attempt any **Three** questions out of remaining **Five** questions.
3.  Draw neat **labelled diagrams** wherever necessary.
4.  All the parts of a question should be **grouped together**.
5.  Figures to the **right** indicate marks

| | | |
|---|---|---|
| **Q.1a** | Write the identifying properties and economic use of the following minerals | **5** |
| **(i)** | Pyrite | |
| **(ii)** | Gypsum | |
| **(iii)** | Quartz | |
| **(iv)** | Muscovite | |
| **(v)** | Diamond | |
| | | |
| **Q.1b** | Explain with labelled diagram | **10** |
| **(i)** | Perched water table | |
| **(ii)** | Dip and strike | |
| **(iii)** | Angular unconformity | |
| **(iv)** | Seismic waves | |
| **(v)** | Dyke | |
| | | |
| **Q.1c** | Answer the following | **5** |
| **(i)** | Parts Gravity Dam | |
| **(ii)** | Hinge of the fold | |
| **(iii)** | Solifluction | |
| **(iv)** | Fissure Eruption | |
| **(v)** | Asthenosphere | |
| | | |
| **Q.2(a)** | Explain theory of plate tectonics with suitable diagram. | **10** |
| **(b)** | What is weathering? Explain Chemical weathering and its engineering consideration. | **6** |
| **(c)** | Give a brief description of layered structure of the earth. | **4** |
| | | |
| **Q.3(a)** | Explain mineralogical and textural classification of igneous rocks | **10** |
| **(b)** | What are the agent of metamorphism, describe Dynamic metamorphism | **5** |
| **(d)** | Explain vesicular and amygdaloidal structures in Igneous rock. | **5** |
| | | |
| **Q.4(a)** | What are Folds? Explain classification of folds on the basis of position of axial Plane. | **10** |
| **(b)** | What are confined and unconfined aquifer? Explain cone of depression in ground water. | **10** |

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**Q.5(a)** Describe the geological conditions for site selection of dam and explain how Geological structures create favourable and unfavourable conditions at a dam site?　**10**

**(b)** Define RQD and Core Recovery, Calculate RQD and Core Recovery from the given data and comment on the suitability of rocks for foundation purpose. Total run 2m.　**10**

| Sample No. | Length of the core in cms | Nature of the lower end of the core sample | | Sample No. | Length of the core in cms | Nature of the lower end of the core sample |
|---|---|---|---|---|---|---|
| a | 12 | N | | i | 26 | N |
| b | 16 | N | | j | 10 | N |
| c | 11 | N | | k | 17 | N |
| d | 09 | M | | l | 18 | N |
| e | 9 | M | | m | 8 | M |
| f | 02 | N | | n | 09 | N |
| g | 12 | N | | o | 09 | M |
| h | 16 | N | | p | 05 | N |

**Q.6** Write short notes on **any 5** of the following-　**5X4=20**
**(i)** Types and causes of landslide
**(ii)** Aquifer
**(iii)** Normal fault
**(iv)** Products of volcano
**(v)** Tectonic cause of earthquake
**(vi)** Porphyritic Texture

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**(3 Hours)**                                      **Max Marks: 80**

**Note:** 1. Question **1** is compulsory.
     2. Attempt any **3** out of remaining five questions.
     3. Assume any suitable data where ever required.

**Q.1**     Attempt any **four**
  **a.** Write a Short note on types of fluids.     **05**
  **b.** Define Buoyancy and explain Archimede's principle,     **05**
  **c.** Explain Pitot tube     **05**
  **d.** Write a note on Mach number and its significance     **05**
  **e.** Write a note on equipotential lines and flow net     **05**

**Q.2 a.** Explain types of flow.     **05**
  **b.** Define metacentric height and derive experimental method for it.     **05**
  **c.** State Bernoulli's Equation Explain each term and state the assumptions of   **10**
     Bernoulli's Equation.

**Q.3 a.** Determine different flow pattern with neat and labelled diagram.     **05**
  **b.** A 150mm X 75mm venturi meter with coefficient of discharge 0.98 is to be   **10**
     replaced by an orifice meter having a coefficient of discharge 0.6. If both the
     meter is to give mercury manometer reading for the discharge of 100 litre/sec.
     and the inlet diameter to remain 150mm, what would be the diameter of orifice.
  **c.** Write a note on Stagnation properties.     **05**

**Q.4 a.** Given velocity of fluid $V= (6+2xy+t)i -(xy^2+10t)j +25k$ What is the   **10**
     acceleration of a particle at (3,0,2) at time t=1?
  **b.** Explain why a 3m cylindrical body 4.2 m long and weighing 4100kg cannot   **05**
     float in water?
  **c.** Explain propagation of pressure waves in detail.     **05**

**Q.5 a.** An orifice meter with orifice diameter 10cm is inserted in a pipe line of 20cm   **10**
     diameter. The pressure gauges fitted upstream and downstream of the orifice
     meter gives the reading of 19.62 N/cm$^2$ and 9.81 N/cm$^2$ respectively. Take Cd
     is 0.6. Find the discharge of water through pipe.
  **b.** Determine the velocity of a bullet if the Mach angle is 30˚. Given the   **10**
     temperature of the air is 22˚C. (k=1.4 and R=287 J/Kg$^o$K).

**Q.6 a.** A 30cmX15cm venturimeter is fitted on a horizontal pipeline discharging oil of   **10**
     specific gravity 0.8. The inlet pressure is 16 N/cm$^2$ and throat pressure is -40cm
     of Hg. If the head lost between inlet and throat is 5% of different pressure head,
     find discharge through pipe.
  **b.** The velocity vector in a fluid flow is given by, $V= 4x^3i-10x^2yj+2tk$. Find the   **10**
     velocity and acceleration of a fluid particle at (2, 1, 3) at time t = 1.

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**Duration: 3 Hours**          **Maximum Marks: 80**

Instructions : (1). Question No .1 is compulsory
   (2) Answer any *Three Questions* from the remaining.
   (3) Each full question carries **20** marks.
   (4) Assume suitable data, if needed and state it clearly.

Attempt **any four**

**Q.1**  a)  A boiler cylindrical shell is subjected to an internal steam pressure of 2   **05**
MPa.  The thickness of shell is 16 mm and permissible stress is 110 MPa.
Calculate the maximum diameter of the boiler, when the efficiencies of
longitudinal and circumferential joints are 70 % & 30 % respectively.

  b)  Enlists the relationship between rate of loading, shear force and bending   **05**
moment and state their applications.

  c)  What must be the length of 5 mm diameter aluminium wire, so that it can   **05**
be twisted through one and half revolutions without exceeding a shearing
stress of 50 MPa ?   Take $G = 27$ GPa & $J (I_p) = 61.3592$ mm$^4$.

  d)  Find the strain energy stored in a solid circular shaft of length 3m and   **05**
diameter 600 mm, if maximum shear stress is 80 N/mm$^2$.  Take $G = 300$
GPa.

  e)  Explain 'Principle of virtual work' in brief.                              **05**

**Q.2**  a)  A portal frame shown in figure. Draw SFD, & BMD for the column AB   **14**
and beam BC only.
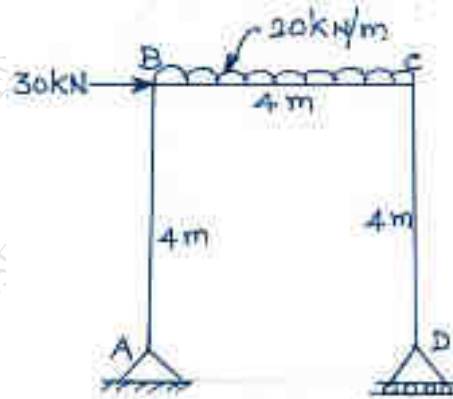


  b)  A seamless spherical shell, 900 mm internal diameter, 10 mm thick.  It is   **06**
Being filled with a fluid under pressure until its volume increases by 160
cm$^3$.  Determine the pressure exerted by the fluid on the shell.
Take $E = 200$ GPa  and $\mu = 0.3$.

**Q.3**  a)  A solid circular shaft 200 mm in diameter is to be replaced by a hollow   **12**
shaft, the ratio of internal diameter to external diameter as 3:5.  Determine
the diameters of hollow shaft, if maximum shear stress is to be the same as
that of a solid shaft.

  b)  Determine the strain energy of a simply supported beam of span 3 m   **08**
having C/S 50 mm wide x 100 mm deep and subjected to a udl of 2 kN/m
over its entire span.  Take $E = 200$ GN/m$^2$.

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**Q.4**  a)  The stresses at a point in a bar are 60 N/ mm$^2$ (tensile) and 40 N/mm$^2$    **10**
(compressive). Estimate normal, tangential and resultant stresses & its
obliquity on an oblique plane making an angle of 70$^0$ with the plane of first
principal stress.  Use Mohr's Circle Method.

   b)  A bar 12 mm diameter gets stretched by 0.4 cm under a steady load of 10    **10**
kN.  What stress would be produced in the same bar by a weight of 10 kN
which falls freely vertically through a distance of 80 mm to a rigid collar
attached at its end?  Take E = 210 x 10$^3$ MPa.

**Q.5**  a)  A seamless cylindrical vessel 3 m long which is closed at the ends has an    **10**
internal diameter of 1000 mm and a wall thickness of 12 mm.  Calculate
the hoop and longitudinal stresses induced and also determine changes in
diameter and length of vessel, if it is subjected to an internal pressure of
1.2 MPa.  Take E = 210 GPa and μ = 0.3.

   b)  A hollow circular shaft is to transmit 500 kW at 110 rpm, the maximum    **10**
torque being 30 % greater than the mean.  If the shear stress is not to
exceed 60 MPa and internal diameter is 0.6 times of external diameter, find
external & internal diameters of the shaft.

**Q.6**  a)  At a point two mutually perpendicular direction the stresses are 80 N/mm$^2$    **10**
tensile and 40 N/mm$^2$ tensile.  Each of above stress accompanied by a
shear stress of 60 N/mm$^2$.  Determine analytically resultant stress and its
obliquity on an oblique plane inclined at an angle 70$^0$ with the axis of
major tensile stress.

   b)  Determine slope and deflection at the free end of a cantilever beam shown    **10**
In figure.  The c/s of beam is 300 mm x 400 mm and E = 12 GPa.  Use
Principle  of Superposition.



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