Total No. of Questions—12] [Total No. of Printed Pages—8+2

[3362]-114

S.E. (Mech./Prod. etc.) EXAMINATION, 2008

ENGINEERING MATHEMATICS—III

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6** from Section I, Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, Q. No. **11** *or* Q. No. **12** from Section II.

(*ii*) Answers to the two Sections should be written in separate answer books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Solve any *three* of the following : [12]

(*i*) $\frac{d^4y}{dx^4} - y = \cosh x . \sinh x$

(*ii*) $(D - 1)^3 y = e^x + 5^x - 1$

(*iii*) $\frac{d^2y}{dx^2} - 4y = e^{2x}\left(1 + x^2\right)$

P.T.O.

(*iv*) $(1 + x)^2 \frac{d^2y}{dx^2} + (1 + x) \frac{dy}{dx} + y = 2 \sin \log (1 + x)$

(*v*) $\left(D^3 + 9\right) y = \text{cosec } 3x$

[Using variation of parameter method].

(*b*) Solve the simultaneous equations :

$$\frac{dx}{dt} - wy = a \cos pt$$

$$\frac{dy}{dt} + wx = a \sin pt.$$

Or

2. (*a*) Solve any *three* :

(*i*) $\left(D^3 - D^2 + 3D + 5\right) y = e^x \sin 3x$

(*ii*) $\left(\frac{d^2}{dx^2} - \frac{2}{x^2}\right)^2 y = 0$

(*iii*) $\frac{d^2y}{dx^2} + 4y = \tan 2x$

[By variation of parameter method]

(*iv*) $\left(D^2 + 2D + 1\right) y = \frac{e^{-x}}{x + 2}$

(*v*) $\left(D^2 - 4\right) y = x \sinh x.$

(*b*) Solve the equation :

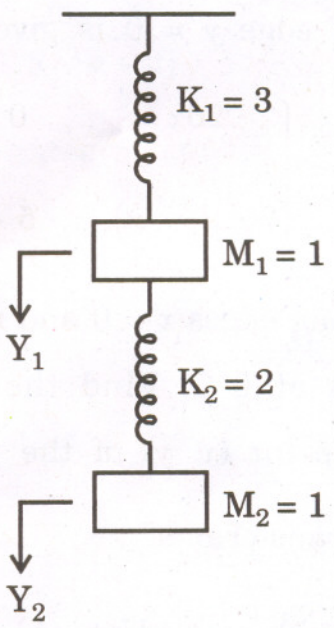
$$\frac{x\,dx}{z^2 - 2yz - y^2} = \frac{dy}{y + z} = \frac{dz}{y - z}.$$

3. (*a*) The vibration of an elastic string is governed by the Partial Differential equation :

$$\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}$$

The length of the string is π and the ends are fixed i.e., $u(0, t) = u(\pi, t) = 0$. The initial velocity is zero and initial deflection is $u(x, 0) = 2 (\sin x + \sin 3x)$. Find the deflection $u(x, t)$ of the vibrating string for $t > 0$. [8]

(*b*) The system shown below begins to move with initial displacement $Y_0 = \begin{bmatrix} 1 \\ \\ 2 \end{bmatrix}$ and initial velocities $\dot{Y}_0 = \begin{bmatrix} -2\sqrt{6} \\ \\ \sqrt{6} \end{bmatrix}$ assuming that there is no friction in the system determine subsequent motion using eigenvalues. [9]



Or

4. (*a*) A mass m suspended from the end of helical spring is subjected to a periodic force $f = F \sin wt$ in the direction of its length. The force f is measured positive vertically downward and at time $t = 0$, mass is at rest in its equilibrium position. If the spring stiffness is S and damping force is negligible, show that the displacement of m at time t from the commencement of motion is given by :

$$x = \frac{F}{m\left(p^2 - w^2\right)}\left[\sin wt - \frac{w}{p}\sin pt\right]$$

where $p^2 = \frac{S}{m}$. [8]

(*b*) A rectangular plate with insulated surface is 10 cm wide and so long compared to its width it may be considered infinite in length without introducing an appreciable error. If the temperature along the short edge $y = 0$ is given by :

$$u(x, 0) = \begin{cases} 20x & 0 < x \leq 5 \\ 20(10 - x) & 5 < x < 10 \end{cases}$$

while the two long edges $x = 0$ and $x = 10$ as well as other short edges are kept at 0°C. Find the steady state temperature $u(x, y)$ at any point (x, y) of the plate. [9]

5. (*a*) Find Laplace transform of :

$$t\int_0^t e^{-3t}\sin 2t\, U(t - \pi)\, dt.$$ [5]

(*b*) Using Laplace Transform method solve : [5]

$$y'' + 2y' + y = 6t\, e^{-t}$$

if

$$y(0) = 2,\ y'(0) = 5.$$

(*c*) Find Fourier cosine transform of $f(x) = e^{-x^2}$. [6]

Or

6. (*a*) Find the inverse Laplace transform of the following (any *two*) : [6]

(*i*) $\dfrac{e^{-s}}{s(s+1)^3}$

(*ii*) $\log\left(\dfrac{s^2 + a^2}{s^2 + b^2}\right)$

(*iii*) $\dfrac{s^2 + 2s - 3}{s(s-3)(s+2)}$.

(*b*) Solve the integral equation :

$$\int_0^\infty f(x) \cos \lambda x = \begin{cases} 1 - \lambda & 0 \le \lambda < 1 \\ 0 & \lambda \ge 1 \end{cases}$$

and hence show that :

$$\int_0^\infty \frac{\sin^2 z}{z^2}\, dz = \frac{\pi}{2}.$$ [5]

(c) Use Appropriate Fourier Transform to solve the equation :

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} \quad 0 < x < \infty \quad t > 0$$

subject to the conditions :

(i) $u(0, t) = 0 \quad t > 0$

(ii) $u(x, 0) = e^{-x} \quad x > 0$

(iii) u and $\frac{\partial u}{\partial x} \to 0$ as $x \to \infty$. [5]

SECTION II

7. (a) The first four moments of a distribution about the value 5 are 2, 20, 40 and 50. From the given information obtain the first four central moment, mean, standard deviation, and coefficient of skewness and kurtosis. [6]

(b) Fit Poisson's distribution to the following data and calculate theoretical frequencies. [6]

x	0	1	2	3	4
f	122	60	15	2	1

(c) In a normal distribution 30% items are under 45 and 8% are over 45. Find mean and standard deviation.

[Data : $P(0 < z < 0.53) = 0.2$, $P(0 < z < 1.28) = 0.42$]. [5]

Or

8. (*a*) An urn contains 6 red balls and 3 white balls. Two balls are drawn at random from the urn, their colours are noted and balls are replaced. This process is repeated 120 times and the results obtained are shown in table :

	0 Red 2 White	1 Red 1 White	2 Red 0 White	Total
Number of drawings	6	53	61	120

(*i*) Determine the expected frequencies.

(*ii*) Determine at 0.05 significance level, whether the results obtained are consistent with these expected. (Use χ^2 – distribution)

$\left[\chi^2_{2:0.05} = 5.999\right]$. [6]

(*b*) If θ is the angle between two lines of regression in case of two variates x and y, show that :

$$\tan\theta = \frac{1+\gamma^2}{\gamma}\,\frac{\sigma_x\,\sigma_y}{\sigma_x^2 - \sigma_y^2}.$$ [5]

(*c*) In 100 sets of 10 tosses of a coin, in how many cases do you expect :

(*i*) 7 heads and 3 tails.

(*ii*) at least 7 heads. [6]

9. (*a*) A particle moves in a straight line $r \cos \theta = a$ in such a way that $\frac{d\theta}{dt} = \omega$ (constant). Find velocity and acceleration. [5]

(*b*) If $\bar{f}$ and $\bar{g}$ are vectors joining the fixed points $A(x_1, y_1, z_1)$ and $B(x_2, y_2, z_2)$ to a variable point $P(x, y, z)$, then prove that :

(*i*) $\nabla\left(\bar{f} \cdot \bar{g}\right) = \bar{f} + \bar{g}$

(*ii*) $\nabla \cdot \left(\bar{f} \times \bar{g}\right) = 0$

(*iii*) $\nabla \times \left(\bar{f} \times \bar{g}\right) = 2\left(\bar{f} - \bar{g}\right)$. [6]

(*c*) If the directional derivative of $\phi = axy + byz + czx$ at (1, 1, 1) has maximum magnitude 4 in the direction parallel to z-axis, find the values of a, b, c. [6]

Or

10. (*a*) Find the tangential and normal component of velocity and acceleration of a particle describing a curve :

$$x = e^t \cos t,\ y = e^t \sin t,\ z = e^t.$$ [6]

(*b*) If $\overline{F}_1$ and $\overline{F}_2$ are irrotational then show that $\overline{F}_1 \times \overline{F}_2$ is solenoidal. [5]

(c) Show that :

$$\overline{F} = \left(2xz^3 + 6y\right)\hat{i} + (6x - 2yz)\,\hat{j} + \left(3x^2\,z^2 - y^2\right)\hat{k}$$

is irrotational. Find scalar potential ϕ such that $\overline{F} = \nabla\phi$. [6]

11. (a) Find the work done in moving a particle once round the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1, z = 0$ under the field of force given by :

$$\overline{F} = (2x - y + z)\,\hat{i} + \left(x + y - z^2\right)\hat{j} + (3x - 2y + 4z)\,\hat{k}.$$ [5]

(b) Evaluate the surface integral :

$$\iint_S \left(yz\,\hat{i} + zx\,\hat{j} + xy\,\hat{k}\right).\,d\overline{S}$$

where S is the surface of the sphere $x^2 + y^2 + z^2 = 1$ in the first octant. [7]

(c) Test whether the motion specified by

$$\overline{q} = \frac{k^2\left(x\hat{j} - y\hat{i}\right)}{x^2 + y^2}$$

possible motion for an incompressible fluid. If so, find the equations of the stream lines. [4]

Or

12. (a) Verify Stokes' theorem for $\overline{F} = -y^3\,\hat{i} + x^3\,\hat{j}$, where C is the boundary of the ellipse :

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, z = 0.$$ [7]

(*b*) Prove that :

$$\iint_S (\phi \nabla \psi - \psi \nabla \phi)\, dS = \iiint_V \left(\phi \nabla^2 \psi - \psi \nabla^2 \phi\right) dV. \qquad [5]$$

(*c*) Find the surface of equipressure in case of steady motion of a liquid which has velocity potential $\phi = \log(xyz)$ and is under the action of a force $\overline{F} = yz\hat{i} + zx\hat{j} + xy\hat{k}$. [4]

Total No. of Questions—12] [Total No. of Printed Pages—8

[3362]-115

S.E. (Mech.) EXAMINATION, 2008

MANUFACTURING PROCESSES–I

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer any *three* questions from each Section.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Explain with suitable sketch, the following types of pattern used in casting process : [4]

(*i*) Sweep pattern

(*ii*) Single piece pattern.

(*b*) Explain the following characteristics of good moulding sand : [4]

(*i*) Permeability

(*ii*) Thermal stability.

(*c*) Explain the working of squeeze moulding machine used in foundry work with suitable diagram. [4]

(*d*) Differentiate between plastic injection and blow moulding process. [4]

P.T.O.

Or

2. (*a*) Explain the purpose of the following allowances provided on pattern : [4]

(*i*) Contraction

(*ii*) Machining

(*iii*) Taper

(*iv*) Distortion.

(*b*) Describe main points while cleaning of casting component after removal from mould. [4]

(*c*) Explain purpose of core used in mould with showing suitable sample of component drawing. Also mention name of that casting component. [4]

(*d*) Differentiate between thermoplastic and thermosetting plastic material used in plastic processes. [4]

3. (*a*) Compare three high rolling and planetary rolling mill with respect to its diagram, application, nature of construction and material of roller. [4]

(*b*) Explain only operation principle of HERF (High Energy Rate of Forming) process with the help of neat sketch. [4]

(*c*) Explain only principle of operation of rotary swaging cold working process with suitable diagram. [4]

(*d*) Explain with neat diagram, the following sheet metal operations : [4]

(*i*) Perforating

(*ii*) Punching.

Or

4. (*a*) Describe systematic sequence of steps in drop forging process in order to finish the forging component for application. [4]

(*b*) Explain the following defects in forging process with its cause and remedies : [4]

(*i*) Incomplete component

(*ii*) Cracks at the corner.

(*c*) Explain with neat sketch, the following accessories used in sheet metal work : [4]

(*i*) Pilots

(*ii*) Stripper plate.

(*d*) Metal cold spinning operation is possible on centre lathe. Comment on it with diagram. [4]

5. (*a*) Describe with the help of suitable working set-up, principle operation of GMAW process. [6]

(*b*) Explain with suitable diagram, the following resistance welding processes : [6]

(*i*) Friction welding

(*ii*) Seam welding.

(*c*) Compare soldering, brazing and braze welding processes. [6

Or

6. (*a*) Describe principle operation of GTAW process with suitab sketch. [6

(*b*) Describe thermit welding process with suitable diagram, als mention field of application. [6

(*c*) Write down characteristics of three different types of flame used in gas welding process. [6

SECTION II

7. (*a*) Only draw block diagram of lathe machine and show the followin parts on it : [4

(*i*) Tail-stock

(*ii*) Head-stock

(*iii*) Half nut

(*iv*) Apron Mechanism.

(*b*) A screw of 1.5 mm pitch is to be cut on a lathe having single start lead screw of 4 T.P.I. Available gears are 20 T to 120 T in steps of 5 T. Also one extra 127 T gear given. Find the gear train. [4]

(*c*) Draw three views of single point cutting tool and show the following elements on it : [4]

(*i*) Negative back rake angle

(*ii*) Lip angle

(*iii*) End flank

(*iv*) Side cutting edge angle.

(*d*) Write down purpose of the following accessories used on lathe machine : [4]

(*i*) Half centres

(*ii*) Coller mandrels.

Or

8. (*a*) Explain with suitable set-up, purpose of tail-stock to drill the hole in work by using twist drill. [4]

(*b*) Find the angle that the compound rest should be set to cut a taper having large diameter 60 mm and smaller diameter 40 mm and length of taper is 80 mm. [4]

(c) Draw three views of single point cutting tool and show the following elements on it : [4]

(i) Zero back rake angle

(ii) Nose radius

(iii) Shank

(iv) Face surface.

(d) Explain with suitable diagram, the following accessories used on lathe machine : [4]

(i) Face plate

(ii) Angle plate.

9. (a) Explain with neat diagram, the following milling operations : [4]

(i) Gear cutting

(ii) Gang Milling.

(b) Index 51 divisions by compound indexing method, the hole circles available : [6]

Plate I = 15, 16, 17, 18, 19, 20

Plate II = 21, 23, 27, 29 31, 33

Plate III = 37, 39, 41, 43, 47, 49

(c) Draw neat sketch of twist drill and show the following elements on it : [4]

(i) Land

(ii) Heel

(iii) Shank

(iv) Flute.

(d) Differentiate between reaming and drilling operation performed on drilling machine. [4]

Or

10. (a) Draw only sketch of universal dividing head and show the following parts on it : [6]

(i) Index plate

(ii) Index crank

(iii) Change gears

(iv) Single threaded worm gear.

(b) Differentiate between up-milling and down-milling methods of milling operation. [4]

(c) Explain with suitable diagram, the following drilling operations : [4]

(i) Counterboring

(ii) Countersinking.

(d) Explain only construction of sensitive type drilling machine with suitable diagram. [4]

11. (*a*) The following letters are printed on a new grinding wheel :

W–C–500–H–4–V–17

Describe the meaning of any *four* letters (except first and last letters) mentioned in the above specification of grinding wheel. [4]

(*b*) Differentiate between Glazing and loading of grinding wheel during operation. [4]

(*c*) Explain with a neat diagram "Thread grinding" operation. [4]

(*d*) Write down applications and disadvantages of "Honning" process. [4]

Or

12. (*a*) Explain grade, structure regarding the specifications of grinding wheel. [4]

(*b*) Excessive dressing of grinding wheel reduce the grinding wheel life. Comment on it. [4]

(*c*) Draw only sketch of external centerless cylindrical grinding process and show grinding wheel, regulating wheel and work. [4]

(*d*) Write down application and advantages of superfinishing process. Also mention any *one* example of it. [4]

Total No. of Questions—**12**] [Total No. of Printed Pages—4+2

[3362]-120

S.E. (Mechanical) EXAMINATION, 2008

MANUFACTURING PROCESSES–II

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (*a*) A job of 40 mm in diameter is being turned on a lathe with a tool having a rake angle 31° and feed 0.15 mm/rev. The length of chip over one revolution of workpiece is 76 mm. The cutting speed is 12 m/min. The tangential force is 415 N and feed force is 175 N.

Calculate :

(*i*) Coefficient of friction on the rake force

(*ii*) Thickness of chip

(*iii*) Angle of shear

(*iv*) Velocity of shear

(*v*) Velocity of chip along tool face. [10]

P.T.O.

(*b*) Sketch and explain the Merchant's circle of cutting forces. [6]

Or

2. (*a*) What is a Tool life ? What are the variables affecting tool life ? [5]

(*b*) What are the functions of cutting fluids ? [5]

(*c*) During machining of an alloy steel with a tool having geometry 0°–5°–6°–6°–8°–75°–1 mm ORS, the tangential force and axial force measured by dynamometer to be 280 N and 130 N respectively. Calculate the radial force, frictional force and co-fficient of friction at the chip tool interface. [6]

3. (*a*) Explain continuous surface Broaching machine with working sketch. [6]

(*b*) Explain the concept of Gear Shaping process with neat sketch. [6]

(*c*) What is a major disadvantage of self-opening Die Heads (Thread Chasers) ? [4]

Or

4. (*a*) Explain the process of Thread grinding with neat sketch. [6]

(*b*) Explain the process of Gear Hobbing with neat sketch. [6]

(*c*) Draw the neat sketch of Broach geometry details. [4]

5. (*a*) Compare NC machines with conventional machines. [6]

(*b*) Write the functions of the following codes :

(*i*) G 02

(*ii*) G 33

(*iii*) G 97

(*iv*) M 03

(*v*) M 06

(*vi*) M 10. [6]

(*c*) Explain linear and circular interpolation with neat sketches. [6]

Or

6. (*a*) Write the functions of the following codes : [6]

(*i*) G 90

(*ii*) G 01

(*iii*) G 63

(*iv*) M 00

(*v*) M 09

(*vi*) M 11.

(*b*) Draw the block diagram of DNC system. Compare DNC and CNC systems. [6]

(*c*) Write short notes on : [6]

(*i*) FMS system

(*ii*) Machining centres.

SECTION II

7. (*a*) What are the different dielectric fluids used in EDM ? List the characteristics of Dielectric Fluid. [6]

(*b*) Explain the principle of Electrochemical Machining with neat sketch. [6]

(*c*) Draw the schematic diagram of Ultrasonic Machining Operation. [4]

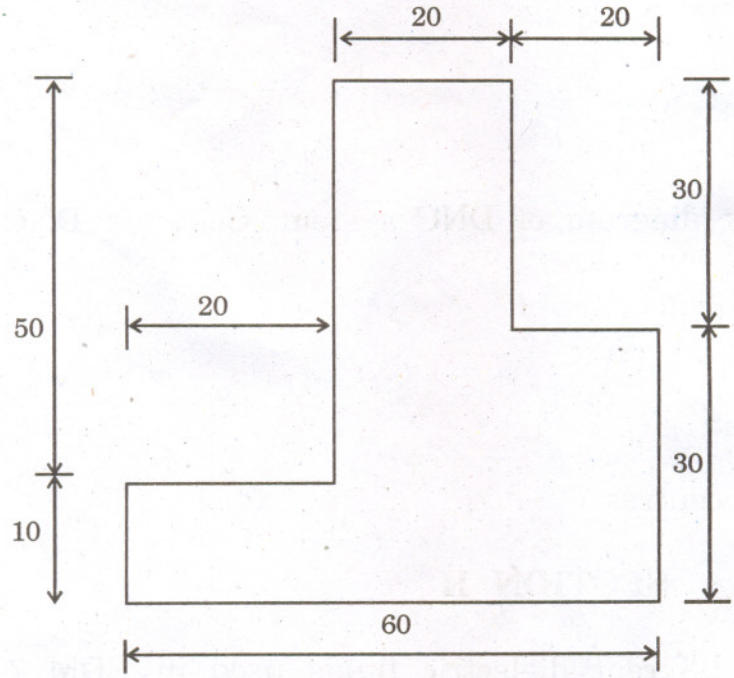
Or

8. (*a*) Explain Laser Beam Machining principle with neat sketch of schematic set up. [6]

(*b*) Explain Electron Beam Machining (EBM) process with schematic diagram. [6]

(*c*) What are the characteristics of electrode material as a good tool in EDM. [4]

9. (*a*) Find the centre of pressure of the following blank : [6]



Thickness of blank = 1.5 mm

Material—Med. C steel

Fig. 1

(*b*) Estimate the blanking force, work done and press tonnage if ultimate shear stress of material is 450 N/mm^2 and if percentage penetration is 30% of material thickness and shear on die is 1 mm.

Also determine the Punch and Die size for the component shown in Fig. 1. [8]

(*c*) What type of stripper is preferred for the blank shown in Fig. 1 ? Justify it. [2]

Or

10. (*a*) What is a function of pilots ? Differentiate between Direct and Indirect pilot with figures. [6]

(*b*) Explain methods of reducing cutting forces in sheet metal work. [6]

(*c*) Define the following terms : [4]

(*i*) Notching

(*ii*) Lancing

(*iii*) Bolster plate

(*iv*) Shut height of press.

11. (*a*) Explain Renewable and slip bushes with neat sketches. [6]

(*b*) Explain C-clamps and quick acting nut with neat sketches. [6]

(c) When do you prefer V-location system ? Explain it with neat sketches. [6]

Or

12. (a) Explain 3-2-1 principle with neat sketches. [6]

(b) Enumerate design principle of drilling jig. [6]

(c) Write a short note on milling fixture. [6]

Total No. of Questions—12] [Total No. of Printed Pages—8

[3362]-113

S.E. (Mechanical) EXAMINATION, 2008

FLUID MECHANICS

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer any *three* questions from Section I and any *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

Unit 1

1. (A) Define surface tension for a liquid and explain how it accounts for :

(*i*) the formation of droplets and liquid jets of round section.

(*ii*) the rise or depression of liquid in a capillary tube. [6]

(B) Determine the torque and power required to turn a 10 cm long, 5 cm diameter shaft at 500 r.p.m. in a 5.1 cm diameter

P.T.O.

concentric bearing flooded with a lubricating oil of viscosity 100 centipoise. [8]

(C) Identify the following substances as fluids or solids and if fluids, classify them further. The values are obtained from isothermal tests. [4]

Substance A	du/dy =	0	0	0	0	0
	τ =	0	0.5	1	1.5	2
Substance B	du/dy =	0	1	2	3	4
	τ =	0	0	0	0	0
Substance C	du/dy =	0	1	2	3	4
	τ =	0	2	4	6	8
Substance D	du/dy =	0	0.5	1	1.5	2
	τ =	0	1	2.5	4	6

Or

2. (A) Define stream function and velocity potential. Show that the lines of constant stream function and velocity potential must intersect orthogonally. [4]

(B) Explain the term acceleration in fluid flow and indicate its components. Under what circumstances is a flow non-accelerating ? [4]

(C) The velocity components in a two-dimensional flow field for an incompressible fluid are expressed as :

$$u = \frac{y^3}{3} + 2x - x^2y$$

$$v = xy^2 - 2y - \frac{x^3}{3}.$$

(*i*) Show that these functions represent a possible case of an irrotational flow.

(*ii*) Obtain an expression for the stream function ψ.

(*iii*) Obtain an expression for the velocity potential ϕ. [10]

Unit 2

3. (A) Explain how horizontal and vertical components of the resultant pressure on a submerged curved surface are determined ? [8]

(B) The diameters of a small piston and a large piston of a hydraulic jack are 3 cm and 10 cm respectively. A force of 80 N is applied on the small piston. Find the load lifted by the large piston when :

(*i*) the pistons are at the same level.

(*ii*) small piston is 40 cm above the large piston.

Assume the liquid in the jack as a water. [8]

Or

4. (A) Explain with neat sketches, the conditions of equilibrium for floating and submerged bodies. [6]

(B) A cone of specific gravity S is floating in water with its apex downwards. It has radius R and vertical height H. Show that for a stable equilibrium of cone :

(*i*) $\sec^2 \alpha > \frac{H}{h}$

(*ii*) $H < \left[\frac{R^2 S^{1/3}}{1 - S^{1/3}}\right]^{1/2}$.

Where α is semi-cone angle, h is depth of immersion. [10]

Unit 3

5. (A) What is a Pitot tube ? How is it used to measure velocity of flow at any point in a pipe or channel ? [6]

(B) What are the different forms of energy in a flowing fluid ? Represent schematically the Bernoulli's equation for flow through a tapering pipe and show the position of total energy line and the datum line. [5]

(C) What is calibration ? How are notches calibrated in a laboratory ? [5]

Or

6. (A) A jet of water coming out from 50 mm diameter rounded nozzle attached to 100 mm diameter pipe is directed vertically downwards. If the pressure in the pipe 20 cm above the nozzle is 200 kN/m^2 gauge, determine the diameter of jet 5 m below the nozzle level. [6]

(B) A 3 m high tank standing on the ground, is kept full of water. There is a small orifice in its vertical side with its centre at depth '*h*' on below the free surface of liquid in the tank. Find the value of '*h*' so that the liquid strikes the ground at the maximum distance from the tank. Assuming Cv = 0.97, calculate the maximum value of the horizontal distance. [10]

SECTION II

Unit 4

7. (A) Derive an expression for Hagen-Poiseuille's formula with usual notations. Hence derive :

$$f = \frac{16}{R_e}.$$

Where f = coefficient of friction between fluid and pipe and

Re = Reynold's Number. [8]

(B) A pipe of diameter 20 cm length 10^4 m is laid at a slope of 1 in 200. An oil of specific gravity 0.9 and viscosity 1.5

poise is pumped up at the rate of 20 lit/sec. Find the head lost due to friction. Also calculate the power required to pump the oil. [8]

Or

8. (A) What are repeating variables ? How are they selected for dimensional analysis ? [6]

(B) The frictional torque T of a disc of diameter 'D' rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by :

$$T = D^2 N^2 \rho \phi \left[\frac{\mu}{D^2 N \rho} \right].$$

Prove this relation using Buckingham's π theorem. [10]

Unit 5

9. (A) Explain the following terms :

(*i*) Compound pipe

(*ii*) Pipes in parallel

(*iii*) Equivalent pipe

(*iv*) Equivalent size of the pipe. [6]

(B) What is syphon ? On what principle does it work ? [4]

(C) Show that the loss of head due to sudden expansion in pipeline is a function of velocity head. [6]

Or

10. (A) Three pipes are connected in series to make a compound pipe. Sizes of the pipes are as below :

	Diameter in mm	**Length in m**
Pipe 1	200	400
Pipe 2	400	800
Pipe 3	600	1200

The ends of this compound pipe are connected with two tanks whose difference of water levels is 20 m. If coefficient of friction for these pipes is same and equal to 0.006, determine the discharge through the compound pipe :

(*i*) neglecting the minor losses and

(*ii*) including the minor losses. [12]

(B) Draw a neat figure of venturimeter and show clearly :

(*i*) The datum line

(*ii*) Hydraulic grade line and

(*iii*) Total energy line for it. [4]

Unit 6

11. (A) Define displacement thickness. Derive an expression for displacement thickness. [9]

(B) Calculate the thickness of the boundary layer at the trailing edge of smooth plate of length 4 m and width 1.5 m, when the plate

is moving with a velocity of 4 m/sec in stationary air. Also determine the total drag on one side of the plate assuming that :

(*i*) the boundary layer is laminar over the entire length of the plate and

(*ii*) the boundary layer is turbulent from the very beginning.

Take kinematic viscosity and density of air as 1.5×10^{-5} m^2/sec and 1.226 kg/m^3 respectively. [9]

Or

12. (A) Define the following terms :

(*i*) Airfoil

(*ii*) Chord length

(*iii*) Angle of attack and

(*iv*) Span of an airfoil. [4]

(B) Differentiate between :

(*i*) Stream-lined body and Bluff body.

(*ii*) Friction drag and Pressure drag. [6]

(C) A square plate of side 2 m is moved in a stationary air of density 1.2 kg/m^3 with a velocity of 50 km/hr. If the coefficients of drag and lift are 0.2 and 0.8 respectively, determine :

(*i*) The lift force

(*ii*) The drag force

(*iii*) The resultant force and

(*iv*) The power required to keep the plate in motion. [8]

Total No. of Questions—12] [Total No. of Printed Pages—4+2

[3362]-118

S.E. (Mech./Prod.) EXAMINATION, 2008

ELECTRICAL TECHNOLOGY

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer **3** questions from Section I and **3** questions from Section II.

(*ii*) Answers to the *two* sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Assume suitable data, if necessary.

Section I

1. (*a*) Explain the action of commutator in dc machines. [5]

(*b*) Explain the Ward-Leonard's method for speed control of dc motor. [5]

(*c*) A 230 V, 4 pole dc shunt motor running at 750 r.p.m gives 7.46 kW with an armature current of 38 A. The armature is wave wound and has 400 conductors. The armature and field resistances are 0.2 Ω and 230 Ω respectively. The voltage drop at each brush is 1 V. Calculate :

(1) Useful flux per pole

(2) Rotational losses

(3) Efficiency of the motor. [7]

P.T.O.

Or

2. (*a*) Why should the dc series motor not be started without any load. State the applications of DC series motor and DC series generator. [4]

(*b*) Why starter is required for dc motor. Explain the function of no-volt and overload releases. What are the drawbacks of 3-point starter ? [7]

(*c*) A 250 V dc shunt motor has an armature resistance of 0.5 Ω and field resistance of 125 Ω. It drives a load at 1000 rpm and takes a current of 25 A. The field circuit resistance is then increased 150 Ω. Calculate the new speed assuming the load torque to be constant. [6]

3. (*a*) Explain procedure for designing the scheme of factory lighting. [6]

(*b*) Explain how reactive power is to be measured in 3-phase balanced star-connected circuit by one wattmeter. [5]

(*c*) A 440 V, 50 Hz, 3-phase supply is connected to a balanced star-connected load. Each phase of load consists of resistance and capacitance. When power is measured by two wattmeters method it is found that W_1 = 700 watts while W_2 = 1750 watts. Calculate :

(1) Power factor of the load

(2) Line current drawn

(3) Resistance and capacitive reactance of each branch. [6]

Or

4. (*a*) With a neat circuit diagram explain the use of CT and PT for the measurement of energy in three-phase balanced star circuit. [6]

(*b*) Define the following terms :

(1) Luminous flux

(2) Luminous intensity

(3) Luminous efficiency

(4) Utilization factor

(5) Depreciation factor. [5]

(*c*) A hall of 25 × 40 m is to be illuminated using two fluorescent lamp fitting consisting of two 40 watts tubes. The luminous efficiency of lamp is 60 lumen. Assume depreciation factor of 0.8 and coefficient of utilisation as 0.75. Calculate total number of lamps required for an illumination of 250 lux on working plane. [6]

5. (*a*) What are the advantages of stationary armature and rotating field in alternator ? [4]

(*b*) Derive the expression for approximate voltage drop in transformer for lagging and leading power factors. [6]

(*c*) An OC and SC test is conducted on 1000 kVA 11 kV, three phase alternator with delta connected armature. The test results are :

OC test : V_{line} = 422 V, I_F = 12 A

SC test : I_a = 52.5 A, I_F = 12 A

Determine full load regulation of an alternator on 0.8 leading power factor. [6]

Or

6. (*a*) With a neat connection diagram and phasor diagram for +30 phase shift explain star delta transformer. [6]

(*b*) Define pitch factor and distribution factor. [4]

(*c*) The open circuit and short circuit test on a 5 kVA, 250/125 V, 50 Hz, single-phase transformer gives the following results :

OC test : 250 V, 0.7 A, 90 W (H. V. side)

SC test : 12 V, 30 A, 90 W (L. V. side)

Find full load efficiency and regulation at 0.8 power factor leading. [6]

Section II

7. (*a*) Compare squirrel cage and slip ring induction motor. Also explain working principle of induction motor. [4+4]

(*b*) A 4 pole, three-phase, 50 Hz induction motor has a voltage between the slip rings on open circuit of 520 V. The star connected rotor has resistance of 0.4 Ω and standstill reactance of 2 Ω per phase. Determine :

(1) Full load torque if full load speed is 1425 r.p.m

(2) The ratio of Tst to Tf.L

(3) The ratio of Tm to Tf.L

(4) The external resistance required in the rotor per phase to get maximum torque at start. [2+2+2+2]

Or

8. (*a*) While delivering an useful power of 24 kW to the full load, 93 phase, 50 Hz, 8 pole induction motor draws a line current of 57 A. It runs at a speed of 720 r.p.m. and is connected to 415 Supply. The p.f. of the motor is observed to be 0.707 lagging, stator resistance per phase is 0.1 Ω mechanical losses and 1000 watts. Calculate :

(1) Shaft torque

(2) Gross torque developed

(3) Rotor copper loss

(4) Stator copper losses

(5) Stator iron losses

(6) Overall efficiency. [8]

(*b*) Using usual notations, derive the generalized torque equation of a three-phase induction motor and also find ratios Tst/Tf.L, Tst/Tm, Tf.L/Tm. [4+4]

9. (*a*) State the types of single-phase induction motor. With the help of a neat diagram, explain the construction and working of capacitor start capacitor run single-phase motor. State its *two* applications. [2+4+2]

(*b*) Why is a synchronous motor not inherently self starting ? Explain different method used to make its self starting. [4+4]

Or

10. Write short notes on (any *three*) :

(*a*) Stepper motor

(*b*) Universal motor

(*c*) Reluctance motor

(*d*) Servo motors [6+5+5]

11. (*a*) Explain important factors to be considered while selecting a motor. [4]

(*b*) State the advantages and disadvantages of a group electric drive and an individual electric drive. [4]

(*c*) A 30 kW, single-phase, 250 V resistance oven is to employ nickel-chrome wire as a heating element. If the wire temperature is 1127°C and that of charge is 527°C, estimate suitable size of the wire if :

(1) Wire is circular in cross-section. [5]

(2) Wire is strip type with thickness of 0.255 mm. [5]

Assume radiating efficiency as 0.57 and emissivity of 0.9 and specific resistance of wire as 1.02×10^{-6} Ωm.

Or

12. (*a*) What are advantages of electric heating ? Explain the working principle of dielectric heating. What are the applications of dielectric heating ? [3+5+2]

(*b*) Explain the procedure for designing heating element with circular cross-section area where '*d*' is the diameter of wire and '*l*' is the length. [8]

Total No. of Questions—12] [Total No. of Printed Pages—4+2

[3362]-119

S.E. (Mechanical) EXAMINATION, 2008

METALLURGY

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer Q. No. **1** *or* **2**, Q. No. **3** *or* **4**, Q. No. **5** *or* **6** questions from Section I and Q. No. **7** or **8**, Q. No. **9** *or* **10**, Q. No. **11** *or* **12** from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Define dislocation. Distinguish between different types of it.

(*b*) Show the following planes and directions in a cubic cell :

(101) $(1\bar{1}0)$ [112] [121].

(*c*) Explain work hardening in brief.

(*d*) What is slip system ? Why is copper more ductile than iron ? [16]

Or

2. (1) Define and derive Schmid's law.

(2) What is point defect ? What are its effects ?

P.T.O.

(3) Explain Recrystallization in brief.

(4) Distinguish between slip and twinning. [16]

3. (1) Compare Brinell and Vickers Hardness test.

(2) An aluminium plate of 0.5 cm thick is to withstand a force of 50,000 N with no permanent deformation. If Aluminium has a yield strength of 125 MPa, what is the minimum width of plate ?

(3) Explain principle of Ultrasonic testing.

(4) With a neat sketch, explain fatigue frature. Also state under what condition such fracture occurs. [16]

Or

4. (1) Distinguish between Charpy and Izad impact test.

(2) A wire of a magnesium alloy 1.05 mm diameter starts deforming plastically at a load of 10.5 kg. The total strain is 0.0081 after loading to 12.1 kg. How much permanent strain will occur with a load of 12.1 kg and what is its yield strength ? Given : E = 45 GPa.

(3) Suggest suitable hardness test for the following. Justify your choice :

(*a*) Gray iron casting

(*b*) Cemented carbide tool

(*c*) Gold plated article

(*d*) Glass.

(4) What is fatigue failure ? How to improve fatigue life ? [16]

5. (*a*) Draw neat, labelled Fe-Fe_3C equilibrium diagram. State reactions of it clearly. [6]

(*b*) Suggest suitable steel for the following and justify your choice (Any *four*) : [8]

(1) Sitar wires

(2) Nuts and bolts

(3) RCC bar

(4) Wood working tools

(5) Connecting rod

(6) Gears.

(*c*) State any *two* limitations of plain carbon steel. Explain in brief effects of Chromium and Molybdenum on properties of steel. [4]

Or

6. (1) Calculate amounts of phases obtainable in 1% C steel under equilibrium conditions, at room temperature. Also define those phases. [6]

(2) Suggest suitable steel for the following applications. Justify your choice (any *four*) :

(*a*) Sanitary fittings

(*b*) Pans used in hotels

(*c*) Forging die

(*d*) Die casting dies

(*e*) Milling cutter

(*f*) Fan blades. [8]

(3) Explain the effects of carbon on properties of plain carbon steel with a suitable graph. [4]

SECTION II

7. (1) Draw TTT diagram for AISI 1080 steel and superimpose CCT diagram of the same steel on it. Highlight the differences between TTT and CCT diagram. [4]

(2) Distinguish between Annealing and Normalising. [4]

(3) Discuss the changes taking place during tempering. [4]

(4) Draw microstructures of : [6]

(*a*) C20

(*b*) Slowly cooled 0.8% C steel

(*c*) Spherodised steel.

Or

8. (1) Represent Martempering, Austempering, patenting and Ausfarming on TTT diagram. State clearly what is the transformation product separately after each treatment. [6]

(2) Why does hardness increase after Hardening heat treatment? [4]

(3) Explain in brief, Nitriding. Is heat treatment required for nitrided component ? Justify your choice. [4]

(4) What is Hardenability ? How is it measured ? [4]

9. (1) Suggest suitable non-ferrous material for the following. Give typical composition of it. Any *four* : [8]

(*i*) Turbine blade

(*ii*) Die cast auto component

(*iii*) Cartridge case

(*iv*) Measuring tape

(*v*) Permanent Magnet

(*vi*) Gun barrel.

(2) Compare Gray cast iron and S.G. iron on the basis of production, microstructure and properties. [4]

(3) White cast iron finds limited applications in engineering industry. True or False. Justify your choice. State typical composition of white cast iron. [4]

Or

10. (1) How malleable cast iron is produced ? Explain in brief. Can this cast iron be rolled ? Justify your choice. [4]

(2) Differentiate steels and cast iron. [2]

(3) What is season cracking ? [2]

(4) Suggest suitable non-ferrous material for the following applications (any *four*). Give typical composition of it :

(*a*) Non-sparking tool

(*b*) Bearings for marine applications

(*c*) Measuring tape

(*d*) Piston

(*e*) Medals

(*f*) Imitation Jewellery. [8]

11. Write short notes on (any *four*) :

(1) Self Lubricated Bearings

(2) Optical Pyrometer

(3) Thermocouples

(4) Limitations of powder metallurgy

(5) Powder characterization. [16]

Or

12. (1) Explain in brief production of cemented carbide tools. [5]

(2) How are thermocouples calibrated ? [3]

(3) What are the advantages of powder metallurgy over other manufacturing technique ? [4]

(4) Is sintering mandatory P/M technique ? [4]

Total No. of Questions—**12**] [Total No. of Printed Pages—**8+3**

[3362]-116

S.E. (Mechanical) EXAMINATION, 2008

THEORY OF MACHINES AND MECHANISM–I

(2003 COURSE)

Time : Four Hours **Maximum Marks : 100**

N.B. :— (*i*) Solve graphical problems on drawing sheets.

(*ii*) Answer *three* questions from Section I and *three* questions from Section II.

(*iii*) Answers to the two Sections should be written in separate answer-books.

(*iv*) Neat diagrams must be drawn wherever necessary.

(*v*) Figures to the right indicate full marks.

(*vi*) Use of logarithmic tables, slide rule, electronic pocket calculator is allowed.

(*vii*) Assume suitable data, if necessary.

SECTION I

Unit I

1. (*a*) Fill in the blanks with proper alternative and rewrite the sentences. [6]

(1) A screw pair with 0 pitch can be called as.....

(*a*) Cylindrical pair

(*b*) Prismatic pair

(*c*) Spherical pair

(*d*) Revolute pair

P.T.O.

(2) In a planar pair, number of Degrees of Freedom is.....

(*a*) 1

(*b*) 2

(*c*) 3

(*d*) 4

(3) In a four bar 'Grashoffian Linkage', if shortest link is grounded, we get.....

(*a*) Double Crank Mechanism

(*b*) Crack-Rocker Mechanism

(*c*) Double Rocker Mechanism

(4) .....mechanisms can be obtained from a double slider simple kinematic chain.

(*a*) Two

(*b*) Three

(*c*) Four

(*d*) Five

(5) .....link can transmit only compressive force.

(*a*) Rigid

(*b*) Flexible

(*c*) Fluid

(6) The type of constraint in a cylindrical pair is.....

(*a*) Incomplete

(*b*) Complete

(*c*) Successful

(*b*) With the help of neat sketches explain all the inversions of single slider crank kinematic chain. [6]

(*c*) Fig. 1 shows schematic of a mechanism. Redraw the free-hand sketch on the answer-book. Find out the total number of kinematic links and number of kinematic pairs. Hence find out the degrees of freedom for the mechanism. [4]

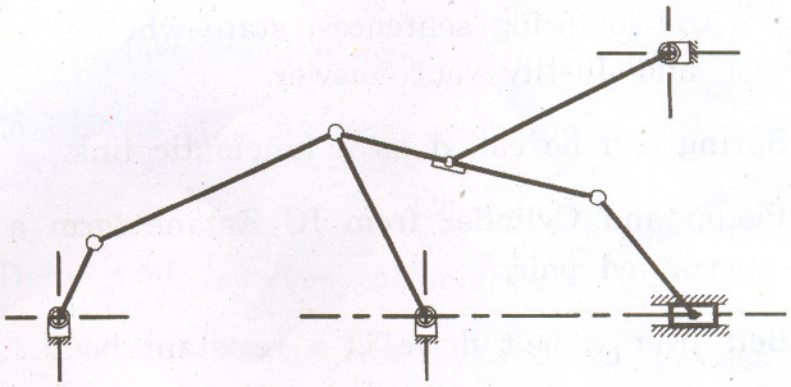


Fig. 1

Or

2. (*a*) Match the pairs by selecting most appropriate alternative from column Q for the elements from column P and write down the correctly formed pairs. [6]

Column P	**Column Q**
(1) Wrist Watch	A. Ternary Link
(2) Telescope	B. Revolute pair
(3) Splined Shaft and Splined Hub	C. Cylinder
	D. Binary Link

(4) Car glass wiper	E. Cylindrical Pair
(5) Grounded link in Whitworth Mechanism	F. Machine G. Mechanism
(6) Piston	H. Crank I. Prismatic pair J. Connecting Rod

(*b*) Rewrite the following sentences, state whether they are True *or* False and Justify your answer. [6]

(1) Spring can be called as a kinematic link.

(2) Piston and Cylinder from IC Engine form a successfully constrained pair.

(3) Belt from a belt drive is a resistant body.

(*c*) Fig. 2 shows schematic of a mechanism. Redraw the free-hand sketch on the answer-book. Find out the total number of kinematic links and number of kinematic pairs. Hence find out the degrees of freedom for the mechanism. [4]

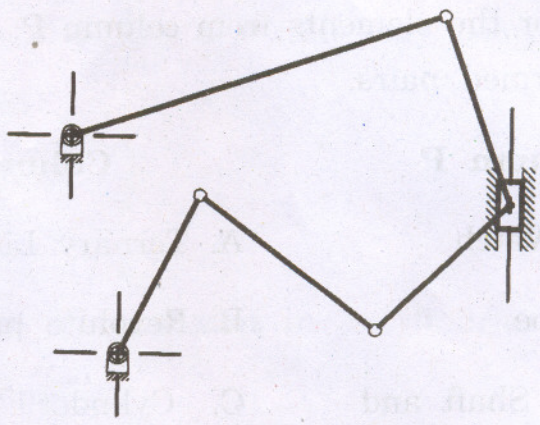


Fig. 2

Unit II

3. (*a*) Draw schematic of Peaucellier's straight line mechanism. Explain its construction and working. Also prove that it accurately traces straight line. Where exact straight line mechanisms are used in day-to-day life ? [8]

(*b*) Write short notes on (any *two*) : [8]

(1) Hart's straight line mechanism

(2) Geneva mechanism

(3) Davis steering gear mechanism.

Or

4. (*a*) Distinguish between the following: [8]

(1) Ratchet Mechanism & Escapement Mechanism

(2) Davis steering gear mechanism & Ackerman steering gear mechanism

(3) Watt's straight line mechanism & Hart's straight line mechanism

(4) Single Hooke's joint & Double Hooke's joint.

(*b*) The driving shaft of a single Hooke's joint rotates at 800 RPM. The angle between driving and driven shafts is 15°. Find the highest and lowest magnitude of driven shaft speed in RPM. [4]

What are the shaft rotation angles starting from standard initial position, for which the velocity ratio is one ? [2]

Also draw the schematic polar diagram of this Hooke's joint, indicating all the important values. [2]

Unit III

5. (*a*) State 'Angular velocity ratio theorem'. What is its formula and its use ? [3]

(*b*) Fig. 3 shows a mechanism in which crank OA is rotating anticlockwise at 10 rad/s. At this instant locate all its ICRs and hence using ICR method find out instantaneous linear velocity of slider D as well as angular velocity of link BC. [15]

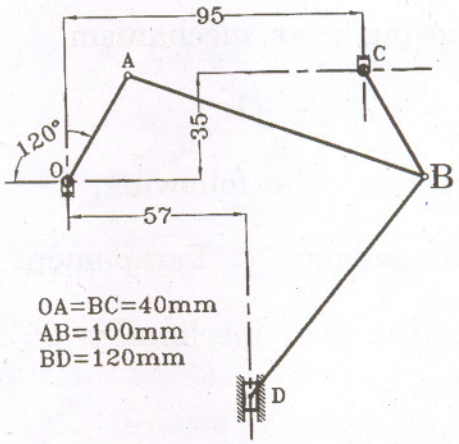


Fig. 3

Or

6. (*a*) What is meant by 'Velocity difference' between two points on the same link ? Explain Velocity Image Principle. What is the use of this principle ? [3]

(*b*) Fig. 4 shows a mechanism in which crank OA is rotating anticlockwise at 20 rad/s. Link CD is in the form of a rod sliding tangentially on an inverted and grounded semi-cylinder as shown.

At the instant shown, find out the linear velocity of slider E using graphical method of velocity polygon. [15]

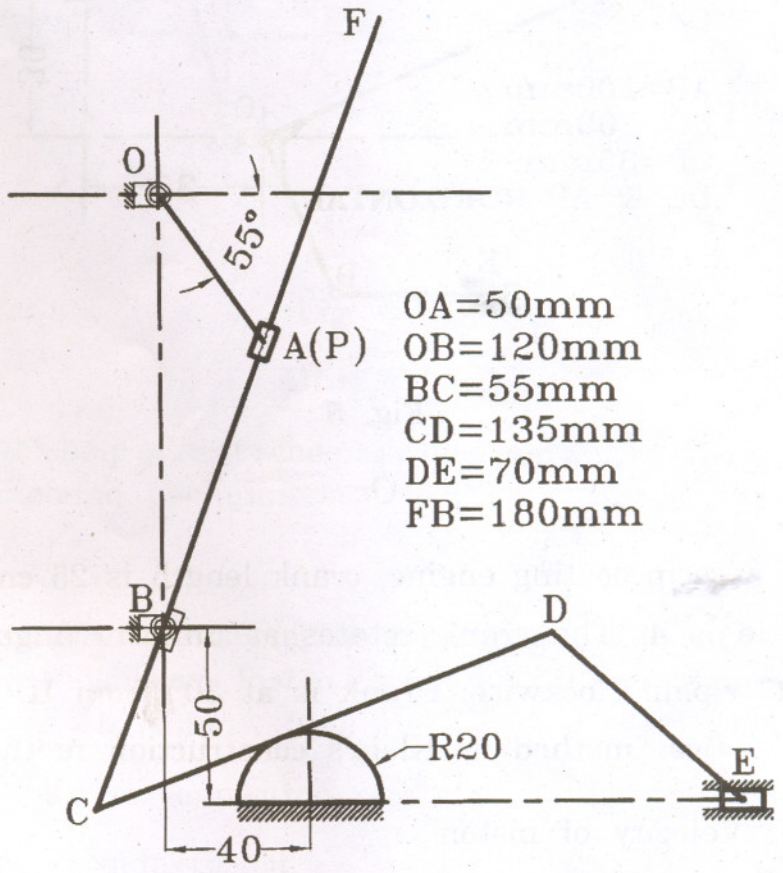


Fig. 4

SECTION II

Unit IV

7. (*a*) Derive loop closure equation for four bar chain mechanism. [4]

(*b*) Fig. 5 shows a mechanism in which crank AP is rotating clockwise at 20 rad/s. At the instant shown determine angular acceleration of 90° bell crank lever COD. [9]

If the instantaneous linear acceleration of piston E is 15000 mm/s^2 towards left, find out the length of link DE. [3]

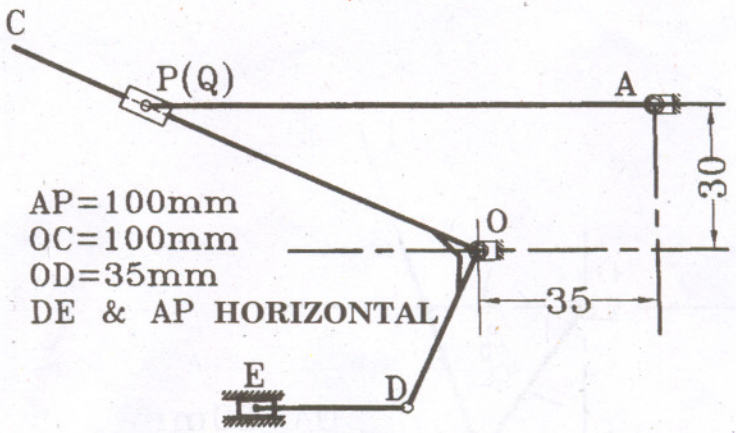


Fig. 5

Or

8. (*a*) In a reciprocating engine, crank length is 25 cm and obliquity ratio is 4. The crank rotates at uniform angular velocity of 300 r.p.m. clockwise. Crank is at 30° from IDC. Using either analytical method or Klein's construction method determine :

(*i*) Velocity of piston

(*ii*) Acceleration of piston

(*iii*) Angular velocity and Angular acceleration of connecting rod. [6]

(*b*) Crank OA of a compound slider crank mechanism, as shown in Fig. 6, rotates at 20 r.p.m. anticlockwise and gives motion to sliding blocks B and D. The dimensions of various links are

OA = 300 mm, AB = 1200 mm, BC = 450 mm and CD = 450 mm. Determine the linear acceleration of block D. [10]

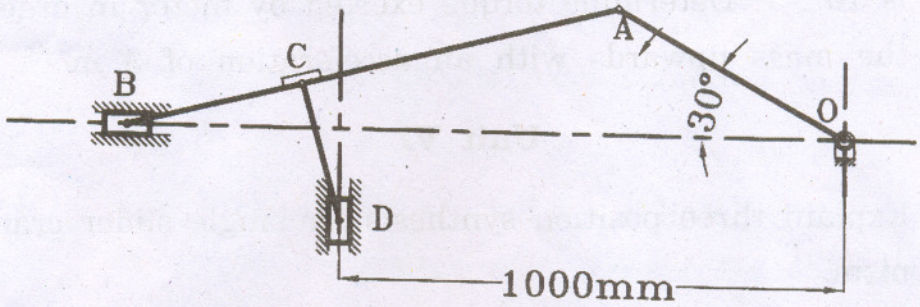


Fig. 6

Unit V

9. (*a*) With the help of neat schematic diagram derive frequency equation of compound pendulum. [8]

(*b*) In IC engine mechanism, the crank length is 40 cm and connecting rod length is 95 cm. Piston diameter is 10 cm and net gas pressure acting is 15 N/mm^2. Find : [8]

(*i*) Thrust on connecting rod.

(*ii*) Piston side thrust.

(*iii*) Torque acting on crankshaft.

(*iv*) Radial load on main bearings when crank is at 45° from TDC.

Or

10. (*a*) Write a short note on D' Alembert's principle. [4]

(*b*) Explain the concept of two point mass dynamically equivalent system [4]

(*c*) A mass of 10 kg is raised by a rope wound around a drum of 300 mm dia. The drum shaft and gear B as a unit has mass moment of inertia 0.01 kgm^2. MI of motor shaft and gear A is 0.05 kgm^2. The speed reduction between motor and drum is 10 : 1. Determine torque exerted by motor in order to move the mass upwards with an acceleration of 3 m/s^2. [8]

Unit VI

11. (*a*) Explain three position synthesis for single slider crank mechanism. [6]

(*b*) Synthesize a four bar mechanism with input link '*a*', coupler link '*b*', output link '*c*' and grounded link '*d*'. Angles θ and ϕ for three successive positions are given in the table below :

	1	2	3
θ	20°	35°	50°
ϕ	35°	45°	60°

If the length of grounded link is 40 mm, using Freudenstein's equation find out other link lengths to satisfy the given positional conditions. Draw the synthesized mechanism in its second position. [12]

Or

12. (*a*) Differentiate between : [6]

(*i*) Analysis of mechanisms and Synthesis of mechanisms

(*ii*) Function Generation and Motion Generation

(*iii*) Type Synthesis and Dimensional Synthesis.

(*b*) A four bar mechanism is to be synthesized by using three precision points, to generate the function $y = x^{1.5}$, for the range $1 < x < 4$. Input link is to start from 30° and is to have a range of 90°. The output link is to start at 0° and is to have a range of 90°. Find out values of x, y, θ (input angles) and ϕ (output angles) corresponding to the three precision points. [6]

(*c*) Fig. 7 shows three positions of link AB. Its length is 100 mm. It is to be moved through the successive positions A_1B_1, A_2B_2 and A_3B_3 with co-ordinates as shown. Graphically synthesize a four bar mechanism with link AB as its coupler. Find out the co-ordinates of the ground pivots in the same reference frame. Also find lengths of input and output links. Draw the mechanism in its second position. [6]

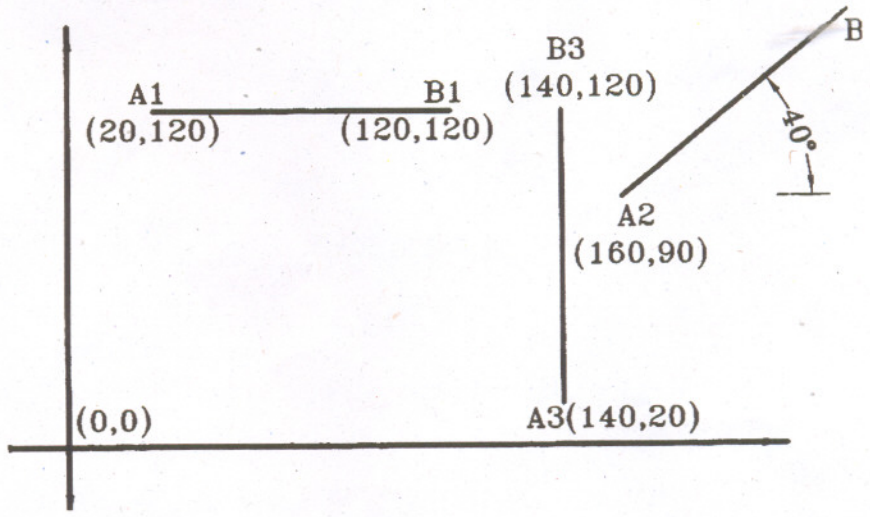


Fig. 7

Total No. of Questions—**12**] [Total No. of Printed Pages—**7**

[3362]-111

S.E. (Mechanical) EXAMINATION, 2008

APPLIED THERMODYNAMICS

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer any *one* question from each Unit.

(*ii*) Answer *three* questions from Section I and *three* questions from Section II.

(*iii*) Answers to the two Sections should be written in separate answer books.

(*iv*) Neat diagrams must be drawn wherever necessary.

(*v*) Figures to the right indicate full marks.

(*vi*) *All* questions carry equal marks.

(*vii*) Use of electronic pocket calculator and steam tables is allowed.

(*viii*) Assume suitable data, if necessary.

SECTION I

Unit I

1. (*a*) State Kelvin-Planck and Clausius Statements of Second Law and prove their equivalence. [6]

(*b*) Prove that entropy is a property of a system. [4]

P.T.O.

(*c*) A refrigerator is to remove heat from the cooled space at a rate of 300 kJ/min to maintain its temperature at –8°C. If the air surrounding the refrigerator is at 25°C, determine the minimum power input required for this refrigerator. [8]

Or

2. (*a*) Prove that change of entropy, for unit mass in case of polytropic process is given by :

$$S_2 - S_1 = \frac{\gamma - n}{\gamma - 1} \cdot R \cdot \ln \frac{V_2}{V_1}$$

where γ = specific heat ratio, n = polytropic index. [6]

(*b*) What is the difference between refrigerator and heat pump ? [4]

(*c*) A Carnot refrigerator operates in a room in which the temperature is 25°C. The refrigerator consumes 500 W of power when operating and has a COP of 4.5. Determine :

(*i*) The rate of heat removal from the refrigerated space.

(*ii*) The temperature of the refrigerated space. [8]

Unit II

3. (*a*) Derive an expression for an air standard efficiency of a diesel cycle. [6]

(*b*) In an Otto cycle, air at 17°C and 1 bar is compressed adiabatically until the pressure is 15 bar. Heat is added at constant volume

until the pressure rises to 40 bar. Calculate the air standard efficiency, the compression ratio and mean effective pressure

$C_{V\ air}$ = 0.717 kJ/kgK, $C_{P\ air}$ = 1.005 kJ/kg K. [10]

Or

4. (*a*) A cylinder contains 0.12 m^3 of air at 1 bar and 90°C. It is compressed to 0.3 m^3, the final pressure being 6 bar. Find the index of compression, increase in internal energy and heat transfer

R = 0.287 kJ/kg K, C_v = 0.717 kJ/kg K. [11]

(*b*) Prove that :

$$\gamma = \frac{C_p}{C_v}$$

where :

C_p = Specific heat at constant pressure.

C_v = Specific heat at constant volume. [5]

Unit III

5. (*a*) What are the limitations of separating calorimeter and Barrel calorimeter ? [6]

(*b*) A vessel contains 4 kg steam at 10 bar and 220°C. Find the volume of the vessel. If the vessel is cooled till pressure drops to 3 bar, find final condition of steam and the heat transfer during cooling. [10]

Or

6. (*a*) Explain effect of superheating and inlet pressure on th performance of Rankine cycle. [6

(*b*) Steam at 20 bar and 360°C expands in a steam turbine to 0.0 bar. It is then condensed in a condenser to saturated water. Th pump feeds back the water to the boiler. Assume ideal Rankin cycle and determine :

(*i*) The network done per kg of steam.

(*ii*) The Rankine efficiency. [1(

SECTION II

Unit IV

7. (*a*) What are the advantages of multistaging of reciprocatin compressor ? [

(*b*) A two-stage single acting reciprocating air compressor drav 06 kg/min air at 01 bar and 20°C. The delivery pressure 15 bar. Assume perfect intercooling with n = 1.25. Clearan factor in low pressure and high pressure cylinders are 0.(and 0.07 respectively. Speed of the compressor is 420 r.p.r Determine :

(*i*) Shaft power, when mechanical efficiency is 85%.

(*ii*) Isothermal efficiency.

(*iii*) Volumetric efficiency in each stage.

(*iv*) Heat transferred in intercooler.

(Take R ± 0.287 kJ/kg°K; C_p = 1.005 kJ/kg°K; C_v = 0.718 k kg°K). [

Or

8. (*a*) Explain the methods to improve isothermal efficiency of a compressor. [6]

(*b*) A single stage single acting air compressor works between 01 bar and 16 bar. Law of compression is $pV^{1.3}$ = constant. Piston speed is 200 m/min. R.P.M. is 350. Indicated power is 30 kW. Determine cylinder dimensions, if the volumetric efficiency of the compressor is 85%. [10]

Unit V

9. (*a*) Explain with neat sketch working of Bomb calorimeter. [10]

(*b*) State the fundamental physical laws, on which, the analysis of combustion process is based upon. [6]

Or

10. (*a*) Explain with neat sketch working of Junker's gas calorimeter. [8]

(*b*) A sample of coal has the following analysis by mass : Carbon 84.4%; Hydrogen 04%; Oxygen 5.6% and remainder is ash. Determine higher and lower calorific values of fuel. One kg of carbon when burnt completely to CO_2, produces 35 MJ of heat. One kg of hydrogen when completely burnt to H_2O, produces 143 MJ of heat. The enthalpy of condensation of water is 2.512 MJ/kg. [8]

Unit VI

11. (*a*) What is Steam Generator ? Classify steam generator. [6]

(*b*) The following readings were recorded during a boiler trial :

(1) Duration = 06 hours.

(2) Mean steam pressure = 12 bar.

(3) Qty. of steam generated = 40,000 kg.

(4) Dryness fraction of steam = 0.85.

(5) Qty. of coal used = 4,000 kg.

(6) C.V. of coal = 33,400 kJ/kg.

Determine :

(*i*) Factor of evaporation.

(*ii*) Equivalent evaporation from and at 100°C.

(*iii*) Boiler efficiency. [12]

Or

12. (*a*) Define the following terms :

(1) Availability

(2) Second law efficiency

(3) Irreversibility

(4) Dead state. [8]

(*b*) One kg of air is contained in a rigid tank at 500 KPa and 700°K. The dead state is taken as 20°C and 100 KPa. Calculate the maximum useful work :

(*i*) If the system were to change to dead state.

(*ii*) When the air is cooled to 400°K, in the tank.

(Take for air, C_p = 1.005 kJ/kg°K; R = 0.287 kJ/kg°K). [10]

Total No. of Questions—12] [Total No. of Printed Pages—8

[3362]-112

S.E. (Mech.) EXAMINATION, 2008

STRENGTH OF MACHINE ELEMENTS

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from each Section.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of logarithmic tables and electronic pocket calculator is allowed.

(*v*) Assume suitable data, if necessary.

SECTION I

Unit I

1. (*a*) Define and explain the following terms :

(*i*) Poisson's ratio

(*ii*) Modulus of rigidity

(*iii*) Volumetric strain

(*iv*) Factor of safety. [8]

(*b*) Draw and explain typical stress-strain diagram for ductile materials indicating all the salient points. [6]

(*c*) A steel bar of diameter 30 mm and length 300 mm is subjected to a pull of 54 kN. The extension and change in diameter of the bar is found to be 0.112 mm and 0.00366 mm respectively. Calculate :

(*i*) Poisson's ratio

(*ii*) Bulk modulus. [4]

P.T.O.

Or

2. (*a*) Explain the following terms in brief :

(*i*) Lateral strain

(*ii*) Thermal stress

(*iii*) Thermal strain

(*iv*) Margin of safety. [8]

(*b*) A bar LMNP, fixed at L and P is subjected to axial forces as shown in Fig. 1. Determine :

(*i*) Forces in portion LM, MN and NP.

(*ii*) Displacement of points M and N.

Take E = 200 GN/m^2. [10

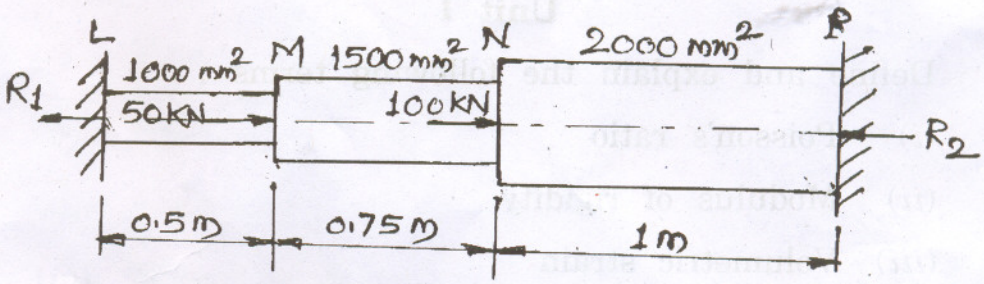


Fig. 1

Unit II

3. (*a*) Explain the following terms in brief :

(*i*) Section modulus

(*ii*) Neutral axis

(*iii*) Moment of resistance.

(*b*) A beam, simply supported at ends, having cross-section as shown in Fig. 2 is loaded with a U.D.L. over its entire span of 8 m. If maximum permissible bending stress in tension is 30 MPa and in compression is 45 MPa,

(*i*) locate NA of the beam from the bottom edge. [2]

(*ii*) find intensity of U.D.L., the beam can carry. [4]

(*iii*) actual tensile and compressive stress induced. [2]

(*iv*) plot bending stress distribution diagram. [2]

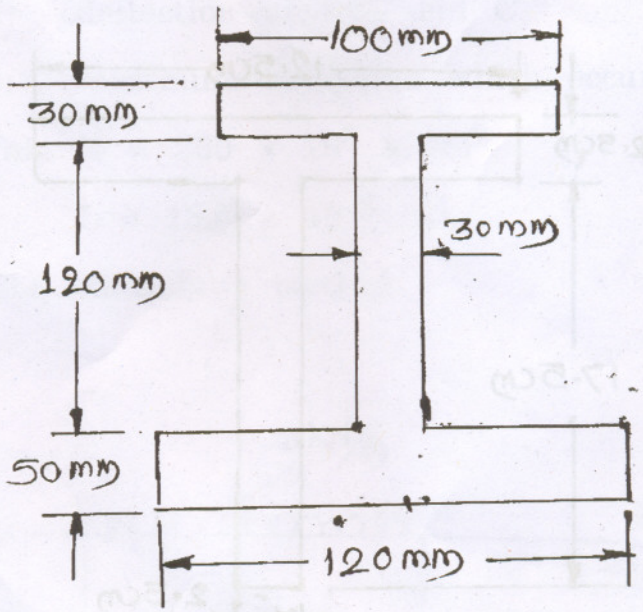


Fig. 2

Or

4. (*a*) State any *six* assumptions made in bending theory. [6]

(*b*) Show the shear stress variations in the following sections :

(*i*) Rectangle

(*ii*) Hollow circle

(*iii*) I-section

(*iv*) Cross. [4]

(*c*) A SSB carries U.D.L. of intensity 2.5 kN/m over its entire span of 5 metres. The cross-section of the beam is a T-section having the dimensions as shown in Fig. 3. Calculate maximum shear stress for the section of the beam. [6]

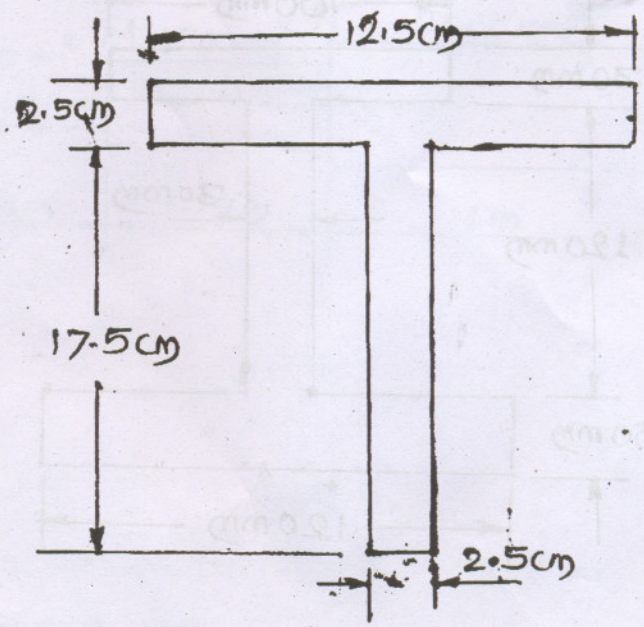


Fig. 3

Unit III

5. (*a*) Using 'Conjugate Beam Method', find slope at supports and maximum deflection for a SSB of span 'L' carrying U.D.L. of intensity '*w*' over its entire span. Flexural rigidity of the beam is 'EI'. [8]

(*b*) Explain 'Mohr's Theorems' as applied to 'Moment Area Method'. [4]

Hence deduce an expression for maximum slope and deflection in case of a cantilever of span 'L', carrying U.D.L. of intensity '*w*' over its entire span. [4]

Or

6. (*a*) For an overhanging beam AC loaded and supported as shown in Fig. 4, determine :

(*i*) deflection at free end C

(*ii*) maximum deflection which occurs between D and E.

Take $E = 200 \times 10^6$ kN/m^2

$I = 13.5 \times 10^{-6}$ m^4.

Use Macaulay's method. [12]

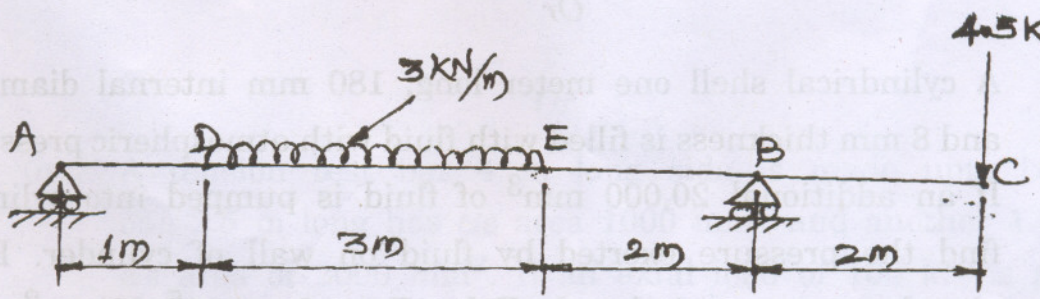


Fig. 4

(*b*) For a cantilever of span 'L', carrying a point load 'W' at its free end, show that the maximum downward deflection is given by :

$$y_{max} = \frac{WL^3}{3EI}.$$ [4]

SECTION II

Unit IV

7. (*a*) Draw Mohr's circle for principal stresses of 80 N/mm^2 tensile and 50 N/mm^2 compressive and find the resultant stresses on the plane making 22° and 64° with major principal plane. Find also the normal and tangential stresses on these planes. [9]

(*b*) A steel pipe of 250 mm diameter and 6 mm thickness is subjected to a pressure of 3 MPa. Calculate the hoop stress in the pipe due to 3 MPa inside pressure and also wound before prestressing with wire of 3 mm diameter. The wire carries a tension of 70 N/mm^2. Determine the stress in wire when pipe is under pressure. Take E = 200 × 10^9 N/m^2, μ = 0.3. [9]

Or

8. (*a*) A cylindrical shell one meter long, 180 mm internal diameter and 8 mm thickness is filled with fluid with atmospheric pressure. If an additional 20,000 mm^3 of fluid is pumped into cylinder find the pressure exerted by fluid on wall of cylinder. Find also hoop stress induced. Take E = 2 × 10^5 N/mm^2 and μ = 0.3. [8]

(*b*) A material is subjected to tensile stress of σ_1 and σ_2 at right angles to each other $\sigma_1 > \sigma_2$. Find the condition that resultant stress makes maximum inclination to normal. [10]

Unit V

9. (*a*) A vertical tie rod is fixed at the top and consists of a steel rod 3 m long and 30 mm diameter encased throughout in a brass tube of 35 mm external diameter and 30 mm internal diameter. The rod and tube are fixed together at both the ends. The composite member is subjected to suddenly applied tensile load of 15 kN through a height of 50 mm and arrested by the tie rod. Calculate maximum stresses in steel and brass. Take E_s = 200 GPa, E_b = 100 GPa. [8]

(*b*) A bar of 5 m long and 50 mm diameter hangs vertically and it has collar attached to it to the lower end rigidly. Determine maximum stresses induced when :

(*i*) weight of 3000 N falls through a height of 100 mm on the collar

(*ii*) a weight of 30000 N falls through a height of 10 mm on the collar.

Take E = 2×10^5 N/mm^2. [8]

Or

10. (*a*) A tension test bar 4 m long side is made upto two parts one 2.5 m long has c/s area 1000 mm^2 and another 1.5 m long c/s area of 2000 mm^2. If an axial load of 100 kN is gradually applied. Find total strain energy produced in bar and compare it with strain energy for a uniform bar of same length and same volume under same load. Take E = 200 GPa. [8]

(*b*) A steel rope lowers a load of 20 kN at the rate of 2 m/sec. During the lowering of the load it is jammed. The unwound length *g* rope is 15 m. What will be instantaneous stress developed and maximum instantaneous enlongation ? Assume diameter of rope 25 mm. Take $E = 2 \times 10^5$ N/mm^2, $g = 9.81$ m/sec^2. [8]

Unit VI

11. (*a*) A circular solid shaft transmits 115 kwatt at 300 r.p.m. If permissible shear stress is 75 N/mm^2 and allowable twist 1.5° in a length of 3 metres. Determine diameter of shaft. Take $G = 82 \times 10^9$ N/m^2. [8]

(*b*) Suggest suitable material for the following application with reason :

(*i*) Engine cylinder

(*ii*) Body of m/c tool

(*iii*) Connecting rod of engine

(*iv*) Wings of Aircraft. [8]

Or

12. (*a*) A hollow shaft of 25 mm outside diameter and 20 mm inside diameter is subjected to a torque of 50 Nm. Find the stress at outside and inside diameter of the shaft. [8]

(*b*) Explain in detail classification of cast iron. Also state application of each type. [8]

Total No. of Questions—12] [Total No. of Printed Pages—4+1

[3362]-117

S.E. (Mech.) EXAMINATION, 2008

I.C. ENGINES AND AUTOMOBILE ENGINEERING

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Your answers will be valued as a whole.

(*vi*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vii*) Assume suitable data, if necessary.

SECTION I

(Unit 1)

1. (*a*) Explain with suitable sketches the working of a four-stroke SI engine. [6]

(*b*) A four-stroke SI engine produces 35 kW power with a mechanical efficiency of 80%. The fuel-air ratio is 1 : 14 and the fuel consumption of the engine is 0.4 kg/kW.hr. The heating value of the fuel is 43000 kJ/kg. Find : [6]

(*i*) the indicated power

(*ii*) the friction power

P.T.O.

(*iii*) the brake thermal efficiency

(*iv*) the indicated thermal efficiency

(*v*) the fuel consumption per hour, and

(*vi*) the air consumption per hour.

(*c*) Draw the theoretical and actual PV diagrams for a Diesel cycle and list the assumptions made in theoretical Diesel cycle. [6]

Or

2. (*a*) Write in brief the modern trends in I.C. engines. [6]

(*b*) Explain the characteristic features of the fuel-air cycle. [6]

(*c*) What are the effects of operating variables on the performance of the fuel-air cycle ? [6]

(Unit 2)

3. (*a*) What are the air-fuel ratio requirements of a petrol engine at different loads and speeds ? [8]

(*b*) List the types of fuel injectors and explain with a neat sketch the working of automatic fuel injector. [8]

Or

4. (*a*) Explain the principle of a helix bypass pump and also draw sketches for different types of plunger helix in use. [8]

(*b*) Explain with a neat sketch working of a solex carburettor. [8]

(Unit 3)

5. (*a*) Explain with a neat sketch the working of a magnetoignition system. [8]

(*b*) Why is governing of I.C. engines required ? List the methods used for governing of I.C. engines. [4]

(c) What is the function of a radiator ? What is the purpose of the fan in radiator system ? [4]

Or

6. (a) Explain with a neat sketch the working of dry sump lubrication system. [8]

(b) What are the types of water cooling systems ? Explain any *one* with a neat sketch. [8]

SECTION II

(Unit 4)

7. (a) State different methods of estimating friction power of an I.C. engines and explain briefly principle of each. [6]

(b) What are S.I. engine performance characteristics ? [4]

(c) A four cylinder four-stroke S.I. engine with 70 mm bore and 100 mm stroke develops torque 140 Nm at 4000 r.p.m. The clearance volume per cylinder is 65 cc. Fuel consumption is 14 kg/hr. Calculate : [8]

(*i*) bp

(*ii*) bmep

(*iii*) brake thermal efficiency if C.V. of fuel is 42500 kJ/kg and

(*iv*) relative efficiency if K = 1.4 for air.

Or

8. (a) List the methods of turbocharging and explain working of pulse turbocharging. [6]

(b) During a trial on an oil engine the following observations were made : [12]

Power absorbed by non-firing engine when driven by an electric motor : 10 kW

Speed of the engine : 1750 r.p.m.

Brake torque : 327.4 Nm

Fuel used : 15 kg/hr

C.V. of fuel used : 42000 kJ/kg

Air supplied : 4.75 kg/min

Quantity of cooling water circulated : 16 kg/min

Outlet temperature of cooling water : 65.8°C

Temperature of exhaust gas : 400°C

Room temperature : 20.8°C

C_p for water : 4.19 kJ/kg.K

C_p for exhaust gas : 1.25 kJ/kg.K

Find :

(*i*) Brake power

(*ii*) Mechanical efficiency

(*iii*) Specific fuel consumption

(*iv*) Draw up heat balance sheet on sec. basis and on percentage basis.

(Unit 5)

9. (*a*) Explain main stages of combustion in S.I. engines. [8]

(*b*) Describe the phenomenon of normal and abnormal combustion in C.I. engines. List the effects of knocking. [8]

Or

10. (*a*) What are the requirements of combustion chambers for S.I. engines ? Explain any *one* type of combustion chamber with a neat sketch. [8]

(*b*) Explain the various stages of combustion in C.I. engines with the help of pressure-crank diagram. [8]

(Unit 6)

11. (*a*) What are the various emission control methods used in I.C. engines ? [8]

(*b*) What are the engine requirements for the automobile applications ? [8]

Or

12. (*a*) What are the pollutants from emissions of a S.I. and C.I. engine ? [8]

(*b*) Write short notes on : [8]

(*i*) Hybrid vehicles

(*ii*) PUC norms.