Seat Number

* 1 8 2 5 *

Fluid Mechanics
(1110, 1100, 1090)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory. Solve **any two** out of a, b, c in each question.
5. Use of non-programmable electronic calculator is allowed.
6. Figures to the right indicate full marks.
7. Assume suitable data & draw neat diagrams, if necessary.

UNIT I

1. a) Define the following. **10**

i) Surface tension and capillarity.

ii) Total pressure and centre of pressure.

iii) Buoyancy and centre of Buoyancy.

iv) Condition for stability of floating & Submerged body.

b) A rectangular pontoon 10.0 m long, 8 m broad and 2 m deep weighs 700 kN. It carries on it's upper deck an empty boiler of 5.0 m diameter weighing 600 kN. The centre of gravity of boiler and the pontoon are at their respective centres along a vertical line. Find the metacentric height, weight density of sea water is 10.104 kN/m^3. **10**

c) i) The velocity distribution in a viscous flow over a plate is given by $u=4y-y^2$ for $y \leq 1.5m$ where u-velocity is in M/s at a points distant y from the plate. If the coefficient of dynamic viscosity is 1.5 pa.s. Determine the shear stress at y = 0 and y = 2.0 m. **5**

ii) Derive the expression for liquid pressure on a curved surface. **5**

UNIT II

2. a) In a two dimensional in compressible flow, the velocity components are given by u =x -4y and v = -y-4x. Show that velocity potential exists and determine its form. Find also the stream function. **10**

b) i) Derive the expression for giving the rate of flow through an Venturimeter in fluid flow. **5**

ii) Define Coefficients of discharge, velocity and contraction and also state the relation between them. **5**

c) The water is flowing through a tapering pipe having diameters 400 mm and 200 mm at section 1 and 2 respectively. The discharge through pipe is 40 litres /sec. The section 1 is 12 m above datum and section 2 is 5 m above datum. Find the intensity of pressure at section 2 of that at section 1 is 350 kN/m^2. **10**

UNIT III

3. a) Derive the expression for incompressible flow between two stationary parallel plates. **10**

b) Oil is pumped through a 75 mm diameter pipe 1.5 Km long. The dynamic viscosity of the oil is 0.1 Ns/m^2. A power input of 5.4 kW with an overall efficiency of 60% at the pump is noted. Determine the quality at oil pumped per minute. Also find the Reynold's number of the flow if relative density of the oil is 0.9. **10**

c) Explain the minor loses in pipes and fittings. **10**

UNIT IV

4. a) The difference in water level of two reservoir which are connected by siphon is 8 m. The length of siphon is 500 m and its diameter is 0.4 m. Determine the discharge if siphon is running full. If summit is 5 m above the surfaces level of upper reservoir. Determine maximum of, inlet leg of pipe to run full. Allow all the losses and assume the permissible minimum pressure at the Summit of Siphon to be 2.5 m of water absolute. Assume frictional loss= 0.02. **10**

b) Derive the expression of velocity of sound wave in fluid. **10**

c) A pipe line of 0.8 m diameter is 2 Km long. To increase the discharge another line of same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, find the increase in discharge if 4 f = 0.04. The head at inlet is 400 mm. **10**

UNIT V

a) Explain main components and explain working of reciprocating pump. **10**

b) Explain velocity and acceleration variation of reciprocating pumps. Explain the importance of air-vessels. **10**

c) Explain with neat sketch working of hydraulic circuit of any machine. **10**

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Seat Number

* 1 8 3 0 *

Electrical Machines & Industrial Electronics
(1120, 1110, 1100)

P. Pages : 2

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Assume suitable data if necessary.
5. Use of Non-programmable Calculator is allowed.
6. Solve **any two** questions from each unit.
7. Draw neat sketches wherever necessary.

UNIT – I **20**

1. a) Explain different methods of electric breaking in dc series motors.

b) Explain the Construction and principle of operation of DC generator.

c) i) What are the different types of DC generator.

ii) A short shunt Compound DC generator supplies a current of 50 A at a voltage of 200 V. Calculate the generated voltage, if the resistance of armature, shunt field and series field windings are 0.04Ω, 50Ω and 0.02Ω respectively.

UNIT – II **20**

2. a) Explain the construction and principle of operation of 3-ϕ induction motor.

b) Explain torque slip characteristics and power flow diagram of 3-ϕ induction motor.

c) Explain the Construction and principle of operation of stepper motor with applications.

UNIT – III

20

3. a) Compare salient pole and non-salient pole Construction of a 3-ϕ alternator and derive the relation between frequency of generated emf, speed and number of poles.

   b) Explain the operation of Solid state relay with applications. Also give the advantages of solid state relays over electromechanical relay.

   c) Explain regulation of an alternator by Synchronous impedance method with neat figures.

UNIT – IV

20

4. a) What are different types of temp. sensors? Explain thermistors with neat diagram. Also write their applications.

   b) Explain the operation of following Switches with a neat diagram.

      i) Thumb wheel Switch.

      ii) Limit Switch.

   c) Explain strain gauge pressure sensors.

UNIT – V

20

5. a) With the help of neat diagram. Explain different components of data acquisition system.

   b) Explain proportional-integral derivative [PID] temperature control with neat figure and also mention the basic types of temperature mode control.

   c) Write a short note on Robotics.

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चंदन - 023

Seat Number

* 1 8 3 3 *

Manufacturing Engineering - II
(1130)

P. Pages : 2

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Solve **any two** bits from each question.
5. Use of non-programmable calculator is allowed.
6. Draw neat sketches wherever necessary.

1. a) Define the various tool parts of a single point cutting tool? Describe the standard angles of cutting tool. **10**

b) In an orthogonal cutting process, following data were observed, chip length of 80mm was obtained with an uncut chip length of 200mm & rake angle used was 20^0. & depth of cut 0.5 mm. The horizontal & vertical components of cutting force F_H F_V were 2000N & 200 N respectively. Determine the shear plane angle, chip thickness, friction angle & resultant cutting force. **10**

c) What is the difference between orthogonal cutting & oblique cutting? **10**

2. a) Define drill jig. Also explain construction of drill jig? What points to be considered in designing drill jig? **10**

b) What are the various clamping devices? Explain any four in detail. **10**

c) Describe the various types of bushes used in jigs & fixtures. **10**

3. a) Explain with neat sketch, the terminology of press working. **10**

   b) Explain in detail, the various types of different press working operations. **10**

   c) Explain the types of dies. Discuss the importance of clearance between die and punch. **10**

4. a) Classify CNC machine? Draw a block diagram of CNC machine and explain it. **10**

   b) What is meant of part programming? What are the steps of programming in CNC machines. **10**

   c) Explain in detail, G-code & M-code. **10**

5. a) Explain in detail 'Plasma arc machining'. Describe its advantages & disadvantages. **10**

   b) What is electro discharge machining? Describe the process stating its advantages and disadvantages. **10**

   c) Write short note on. **10**

      i) Laser beam machining.

      ii) Ultrasonic machining.

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Seat Number

* 1 8 5 4 *

Engineering Mathematics - III
(124111 / 214111)

P. Pages : 4

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Use of non-programmable electronic calculator is allowed.
5. Figures to the right indicates full marks.
6. Use of statistical table is allowed.

UNIT - I

1. Attempt **any two.**

a) i) Solve $(D^2-2D)y = 2^x \cos[(\log 2)x+3]$ **4**

ii) Solve $(D^3-4D)y = 2\cosh^2(2x)$ **4**

b) i) $(D^2+1)y = \tan x$, solve by V.P. Method **4**

ii) Solve : $\left(D+\frac{1}{x}\right)^2 y = \frac{1}{x^4}$ **4**

c) Solve $(D^4+1)y = 2\sinh x \sin x$ **8**

UNIT - II

2. Attempt **any two**

a) A mass 'm' suspended from the end of a helical spring is subjected to a periodic force f = F sinωt in the direction of it's length. The force 'f' is measure positive vertically down words & at zero time 'm' is at rest. If the spring stiffness is 'S', prove that the displacement of 'm' at time 't' from the commencement of motion is given by **8**

$x = \frac{F}{m(p^2-\omega^2)}\left(\sin\omega t - \frac{\omega}{p}\sin pt\right)$ where $p^2 = \frac{s}{m}$ & damping effects are neglected.

b) Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ if **8**

i) u is finite $\forall$ t

ii) u = 0 when $x = 0, \pi \forall t$

iii) $u = \pi x - x^2$ when t = 0 & $0 \le x \le \pi$.

c) An infinitely long plane uniform plate is bounded by two parallel edges in the y-direction & an end at right angles to them. The breadth of the plate is π. This end is maintained at temperature 'u_0' at all points & other edges at zero temperature. Find the steady state temperature function u (x, y). **8**

UNIT - III

3. Attempt **any two.**

a) i) Find $L\left[\int_0^t \sinh t/4 \cdot \sin\frac{\sqrt{5}}{4}t\, dt\right]$ **4**

ii) Find $L^{-1}\left[\frac{1}{S}\log\left(\frac{S+4}{S+5}\right)\right]$ **4**

b) i) Find $L^{-1}\left[\frac{Se^{-2s}}{S^2+2S+2}\right]$ **4**

ii) If $\int_0^\infty e^{-2t}\sin(t+\alpha)\cos(t-\alpha)dt = \frac{3}{8}$ find 'α'. **4**

c) Solve $(D^2+2D+5)y = e^{-t}\sin t,\ y(0)=0,\ y'(0)=1$ **8**

UNIT - IV

4. Attempt **any two.**

a) i) The first four moments of a distribution about the value 4 of the variable are -1.5, 17, -30 & 108. Find β_1 & β_2. **4**

ii) The daily wages of 1,000 workmen are normally distributed around a mean of Rs. 70 & with a S. D. of Rs. 5. Estimate the number of workers whose daily wages will be between Rs. 70 & Rs. 72. **4**

b) i) IF 'x' is a Poisson variate with mean 'λ' then show that **4**

$$P(x+1)=\frac{\lambda}{x+1}P(x).$$

ii) 12% of the items produced by a machine are defective. What is the probability that out of a random sample of 20 items produced by the machine, 5 are defective. **4**

c) From the data given below find : **8**

a) The two regression coefficients
b) The two lines of regression.
c) The coefficient of correlation between the marks in Economics & Statistics.
d) The most likely marks in statistics when marks in Economics are '30'.

Marks in Economics	25	28	35	32	31	36	29	38	34	32
Marks in Statistics	43	46	49	41	36	32	31	30	33	39

UNIT - V

5. Attempt **any two.**

a) i) Using inverse Fourier cosine transform find f(x), if **4**

$$F_c(\lambda)=\begin{cases}\sqrt{2/\pi}\left(a-\lambda/2\right), & \lambda \le 2a\\ 0, & \lambda > 2a\end{cases}$$

ii) Find the directional derivative of $\phi = xy^2 + yz^3$ at (2, -1, 1) along the line $2(x+2)=(y-1)=1-z$. **4**

b) i) If the vector field 4

$\overline{F} = (x+2y+az)\,\overline{i} + (bx-3y-z)\,\overline{j} + (4x+cy+2z)\,\overline{k}$

is irrotational find a,b,c.

ii) If $\overline{A}$ & $\overline{B}$ are irrotational vectors prove that $\overline{A} \times \overline{B}$ is Solenoidal Vector. 4

c) Using Fourier integral representation, show that 8

$$\int_0^\infty \frac{\cos\lambda x + \lambda \sin\lambda x}{1+\lambda^2}\, d\lambda = \begin{cases} 0, & x<0 \\ \pi/2, & x=0 \\ \pi e^{-x}, & x>0 \end{cases}$$

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Seat Number

* 1 8 5 9 *

Theory of Machines - I
(124112 / 214112)

P. Pages : 4

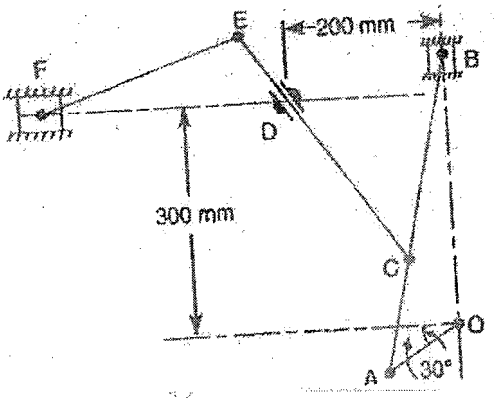
Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Attempt **any two** sub questions from each unit.
5. Use of non-programmable calculator is allowed.
6. Assume suitable data if necessary.
7. Graphical numericals should solve on sheet.

UNIT - I

1. a) In mechanism shown in figure. The crank OA is 100mm long & rotates clock wise about 0 is 120 r. p. m. The connecting rod AB is 400mm long. At point C on AB, 150mm from A the rod CE 350mm long is attached. **8**

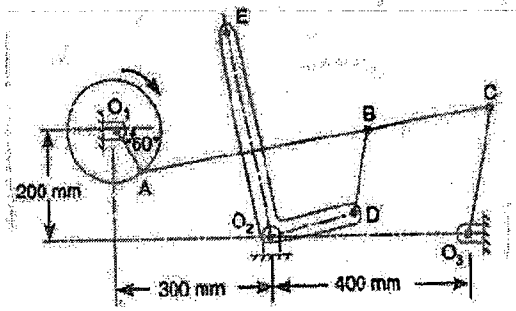


This rod CE Slides in a slot in a trunnion at D. The end E is connected by a link EF, 300 mm long to the horizontally moving slider F.

Find 1) velocity of F
2) velocity of sliding of CE in trunnion &
3) angular velocity of CE.

b) The mechanism is as shown in figure has O_1A = 100mm, AC = 700mm, BC = 200mm, O_3C = 200mm, O_2E = 400mm , O_2D = 200mm BD = 150mm. 8

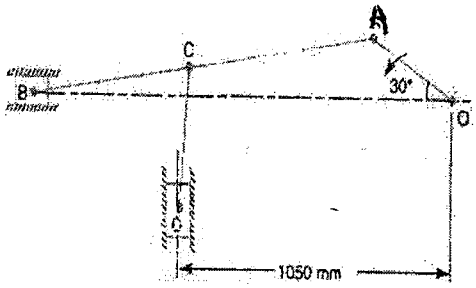
The Crank O_1A rotates a uniform speed of 100rad/sec. Find velocity of point E by Instantaneous centre method.



c) Sketch & explain in detail whitworth quick return motion mechanism. 8

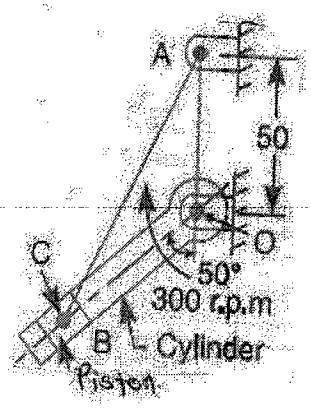
UNIT - II

2. a) In mechanism shown in figure. Crank OA rotates at 20 r. p. m. anticlock wise & give motion to sliding block B & D. OA = 300mm, AB = 1200mm, BC = 450mm & CD = 450mm. 8



Determine
1) velocity of sliding at B & D.
2) angular velocity of CD.
3) linear acceleration of D.
4) angular acceleration of CD.(By Graphical method)

b) The kinematic diagram of one of cylinders of rotary engine is shown in figure. The crank OA which is vertical & fixed is 50mm long. The length of connecting rod AB is 125mm. The line of stroke OB is inclined at 50° to the vertical. The cylinders are rotating at a uniform speed of 300 r. p. m. in clockwise derection about fixed centre O. 8



Determine
1) acceleration of piston inside the cylinder &
2) angular acceleration of connecting rod.

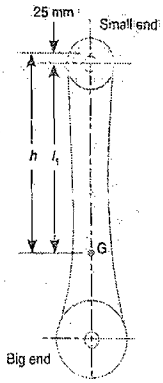
c) Explain klein's construction procedure for slider crank mechanism with neat diagram by taking angle of indination for crank. **8**
1) 0°
2) 90° with I.D.C.

UNIT - III

3. a) Describe watt's parallel mechanism for straight line motion & derive the condition under which the straight line is traced. **8**

b) How are angular velocity & acceleration of connecting rod of a single slider crank chain determined analytically? **8**

c) A connecting rod is suspended from a point 25mm above centre of small end, & 650mm above it's centre of gravity it's mass being 37.5kg. When permitted to oscillate, the time period is found to be 1.87 seconds. Find dynamical equivalent system constituted of two masses, one of which is located at the small end centre. **8**



UNIT - IV

4. a) A load of 10KN is raised by means of a screw jack, having a square threaded screw of 12mm pitch & of mean diameter 50mm. If a force of 100N is applied at the end of a lever to raise the load. What should be length of lever used? Take $\mu = 0.15$ what is mechanical advantage obtained? State whether the screw is self locking. **8**

   b) A thrust shaft of a ship has 6 collars of 600mm external diameter & 300mm internal diameter. The total thrust from the propeller is 100KN. if $\mu = 0.12$ & speed of engine 90 r. p. m. find power absorbed in friction at the thrust block. assuming **8**
   1) uniform pressure &
   2) uniform wear

   c) Describe with a neat sketch a centrifugal clutch & deduce an equation for the total torque transmitted. **8**

UNIT - V

5. a) A V-belt having a lap of 180° has a cross sectional area of 6 cm^2. It runs into a groove of 45°. The density of belt material is 1.4gm/cm^3 and maximum stress in the belt is limited to 4MPa. Assuming coefficient of friction to be 0.15, find the maximum power that can be transmitted & corresponding speed of belt. **8**

   b) Determine the width of a 9.75mm thick leather belt required to transmit 15 kw from a motor running at 900 r. p. m. The diameter of driving pulley of motor is 300mm. The driven pulley runs at 300 r. p. m. & the distance between centre of two pulleys is 3 metres. The density of leather is 1000 kg/m^3. The maximum allowable stress in leather is 2.5MPa. The coefficient of friction between leather & pulley is 0.3. Assume open belt drive & neglect sag & slip of belt. **8**

   c) The reduction of speed from 360 r. p. m. to 120 r. p. m. is desired by the use of chain drive. The driving sprocket has 10 teeth. Find the number of teeth on the driven sprocket. If pitch radius of the driven sprocket. is 250mm & the centre to centre distance between the two sprocket is 400mm find the pitch and length of chain. **8**

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Seat Number

* 1 8 6 2 *

Applied Thermodynamics
(124113 / 214113)

P. Pages : 3

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory. Solve **any two** bits from a, b, c.
5. Use of non-programmable calculator, steam tables Mollier chart is allowed.
6. Neat diagram must be drawn, if necessary.
7. Assume Suitable data, if necessary.

1. a) Prove that the draught produced, in mm of water head by a chimney is given by. **8**

$$h_w = 353H\left[\frac{1}{T_a} - \frac{1}{T_g}\left(\frac{ma+1}{ma}\right)\right]$$

Further prove that the discharge will be maximum for the given height of the chimney, when

$$\frac{T_g}{T_a} = 2\left(\frac{m_a+1}{m_a}\right)$$

Clearly mention the assumption made.

b) i) What is IBR. **4**

ii) What is waste heat recovery of boiler. **4**

c) In a boiler, the following observation were made. **8**

Pressure of steam	=	10 bar
steam condensed	=	540 Kg/hr.
fuel used	=	65 kg/hr.
moisture infuel	=	2% by mass.
mass of dry flue gases	=	9 Kg/ Kg of fuel.
L.C.V. of fuel	=	32,000 KJ/ Kg
Temperature of the flue gases	=	325°C.
Temperature of boiler house	=	28°C.
Feed water temperature	=	50°C.
Mean specific heat of flue gases	=	1 KJ/Kg K.
Dryness fraction of steam	=	0.95.

Draw up a heat balance sheet for the boiler in KJ.

2. a) Draw the Rankine cycle on P-V and T-S diagram using dry Saturated steam and obtain an expression for the Rankine cycle efficiency. **8**

b) i) What are the various sources of air leakage into a steam condenser? How does it affect the performance of the condensing plant? **4**

ii) The following data were obtained from the test of a surface condenser: **4**

Condenser vacuum	=	711 mm of Hg.
Hot well temperature	=	32° C.
Inlet temperature of circulated water	=	12° C.
Outlet temperature of circulated water	=	28° C.
Barometer reading	=	760 mm of Hg.

Calculate the vacuum efficiency and efficiency of the condenser.

c) Steam at a pressure of 15 bar and 250° C is first expanded through a turbine to a pressure of 4 bar. It is then reheated at a constant pressure to the initial temperature of 250° C and is finally expanded to 0.1 bar using Molier chart estimate the work done per Kg of steam flowing through the turbine and the amount of heat supplied during the process of reheat. Also find the work output when the expansion is direct from 15 bar to 0.1 bar without any reheat. Assume all expansion processes to be isentropic. **8**

3. a) What are the effects of friction on the flow through a steam nozzle? Explain with the help of h-s diagram. **8**

b) i) Define Mach number and sonic velocity. **4**

ii) Explain the supersaturated or metastable flow of steam through a nozzle and the significance of Wilson's line. **4**

c) Dry saturated steam at 10 bar is expanded isentropically in a nozzle to 0.1 bar using steam tables only. Find the dryness fraction of the steam at exit. Also find the velocity of steam leaving the nozzle when **8**
i) initial velocity is negligible and

ii) initial velocity of the steam is 135 m/s.

4. a) Prove that the volumetric efficiency of a single stage compressor is given by. **8**

$$\eta_v = 1 - \frac{Vc}{Vs}\left[\left(\frac{P_2}{P_1}\right)^{\frac{1}{n}} - 1\right]$$

b) i) Define F.A.D. and Double acting compressor. **4**

ii) Draw Actual P-V indicator diagram for single stage and two stage compressor. **4**

c) The following observations are recorded during a trial on a two-stage single acting reciprocating air compressor FAD = 6 m^3/min. Atmospheric pressure and temperature are 1 bar and 27° C. Delivery pressure = 40 bars, speed = 400 rpm. Intermediate pressure= 6 bar. Temperature at the inlet to the second stage = 27° C. Low of compression $P V^{1.3} = C$, η_{mech}=80% stroke of L.P = Diameter of L.P. = stroke of H. P. Calculate **8**
i) Cylinder diameter ii) Power required.
Neglect clearance.

5. a) Explain Roots blower and Derive an expression for efficiency of a roots blower in terms of pressure ratio. **8**

b) i) Explain fan characteristics. **4**

ii) Explain axial flow fan. **4**

c) Explain in details the working of screw type compressors. **8**

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Seat Number

* 2 1 4 3 *

Basic Electrical Drives & Controls
(124114 / 214114)

P. Pages : 3

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Attempt **any two** sub – question from each unit.
5. Assume suitable data wherever necessary.
6. Neat diagrams must be drawn wherever necessary.
7. Use of non – programmable electronic calculator is allowed.
8. Figure to the right indicate full marks.

1. Attempt **any two.**

a) Derive the expression for total active power consumed by three phase balanced delta connected load, using two wattmeter method. Draw neat ckt and phasor diagram. **8**

b) Show that reactive power in $3-\phi$ balanced star connected load can be measured by one wattmeter method draw necessary circuit and phasor diagram. **8**

Also explain the effect of load power factor on wattmeter readings W_1 & W_2.

c) i) State the laws of Illuminations. **3**

ii) State the requirements of good lighting scheme ? What are special purpose lightings. Explain in detail the flood lighting. **5**

2. Attempt **any two.**

a) A four pole wave wound 1500 rpm, shunt generator has Armature and shunt field resistances of 0.2Ω and 100Ω respectively. The Armature has 320 conductors & flux per pole is 20mwb. If load resistance is 10Ω – find. **8**

i) Load voltage ii) Load current

iii) Armature current iv) Power output

v) Power developed in Armature.

b) State the three main characteristics of D.C. motor and explain these characteristics for D. C. shunt and series motors. Also state the applications of DC motors. **8**

c) Explain the Necessity of starter in D.C. Motor. Draw and explain 3 – point starter used for D. C. Motor. Also explain the function of protective devices used in 3 – point starter. **8**

3. Attempt **any two.**

a) Derive from first principle, the emf equation of single phase transformer. **8**
What is efficiency of 1–ϕ transformer ? Also derive the condition for maximum efficiency.

b) Derive the torque equation of 3–ϕ, induction motor ? Explain torque – slip characteristics. Also draw the power stages in 3–ϕ I.M. **8**

c) Write short notes on – **8**
i) Scott connections in 3–ϕ transformer.
ii) Auto – transformer starter used for 3–ϕ, induction motor.

4. Attempt **any two.**

a) Why single phase induction motor is not self starting explain ? Also state the types of 1–ϕ induction motors & explain capacitor – split phase, 1–ϕ induction motor. **8**

b) Derive from first principle, the EMF equation of three phase alternator. Also define pitch factor and distribution factor with their standard values. **8**

c) i) Draw phasor diagram of alternator on load at logging and leading power factor. **4**

ii) Draw and explain the type of Rotor used for Alternator. **4**

5. Attempt **any two.**

a) Draw and explain electromechanical control Relay and compare it with solid state relay. **8**

b) Draw schematic block diagram of Data acquisition system ; and Explain each block in detail. **8**

c) Write short note on : **8**

i) Robotics – Block diagram and operation.

ii) Hall effect sensors.

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चंदन - 005

Seat Number

* 2 1 4 5 *

Manufacturing Engineering - II
(124115 / 214115)

P. Pages : 2

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Figure to the right indicate full marks.
5. All questions are compulsory. Solve **any two** bits out of **a, b, c** in each question.
6. Draw neat sketches wherever necessary.
7. Use of non-programmable electronic calculator is allowed.

1. a) Discuss various type of tool wears. **8**

b) Discuss Taylor's relationship for cutting speed - tool life. **8**

c) What do you understand by the term 'Tool Designation' or 'Tool Signature'? Describe the tool represented by 10,10, 6, 6, 8, 8, 1 mm in ASA system. **8**

2. a) What are the main differences between jig and a fixture? Name the essential elements which make up jig or a fixture. **8**

b) Illustrate any two quick acting clamps. **8**

c) Explain the following terms as applied to jigs & fixtures. **8**

i) Fool proofing ii) Clearance
iii) Trunnions iv) Ejectors

3. a) With the help of neat sketch, explain principle of metal cutting. **8**

b) What are various shearing operations in press working? **8**

c) Explain the following terms. **8**
   i) Bend allowance
   ii) Springback.

4. a) Enlist the principle elements of an internal broach. **8**

b) Discuss various gear finishing operations. **8**

c) What is 'Machining Centre'? **8**

5. a) Explain the operating principle of AJM. What are the main controlling parameters that influence the process performance? **8**

b) What are the basic requirements for a successful electrolyte and tool material used for ECM. **8**

c) Write a short note on following. **8**
   i) EBM
   ii) PAM

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Seat Number

* 2 1 4 6 *

Strength of Materials
(123103 / 213103)

P. Pages : 4

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

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3. Students should note, no supplement will be provided.
4. All questions are compulsory and solve **any two** out of a, b & c.
5. Use of non-programmable calculator is allowed.
6. Assume suitable data if necessary.
7. Attempt complete question at one place only.

UNIT – I

1. a) Define limit of proportionality and elastic limit. **8**

Solve : A square bar 50 mm x 50 mm is subjected to a compressive load of 500 kN. The contraction over 200 mm length is 0.5mm and increase in thickness is 0.04 mm. Calculate Poisson's ratio, young's modulus, bulk modulus and volumetric strain.

b) Define Factor of safety and nominal breaking stress. **8**

Solve : Two copper rods and one steel rod together support a load of 250 kN as shown in fig. 1. Find the stresses in the rods.

Take $E_S = 2 \times 10^5$ N/mm^2 , $E_C = 1 \times 10^5$ N/mm^2

$A_S = 1600 mm^2$, $A_C = 1000\,mm^2$

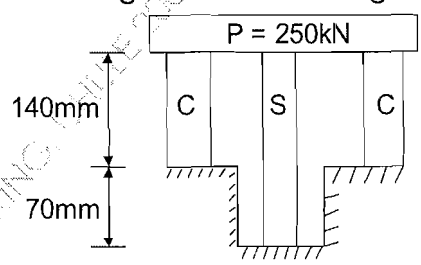

Fig.1

c) Explain Thermal stresses and thermal strains. 8

Solve : A steel rod AB of diameter 30 mm and length 680 mm is held between two supports at ends A and B. Temperature of the rod is raised uniformly from 26°C to 64°C. Assuming the rod to be stress free at 26°C, Find thermal stress and thermal strain if the supports –

i) do not yield

ii) at right yield by 0.2 mm

Take E = 210 GPa, $\alpha = 12.5 \times 10^{-6}$ per °C.

UNIT – II

2. a) Explain resultant stress and angle of obliquity. 8

Solve : At a point in a strained material the normal stresses acting are 50 MPa and –30MPa at a plane right angle to each other, with a shear stress of 20 MPa. Determine :

i) Principal stresses and their nature.

ii) Normal and tangential stress on a plane inclined at angle of 25° with the plane of 50 MPa.

b) Draw Mohr's circle for the element subjected to state of shear intensity 'τ' only. 8

Solve : At a point in a strained material the bending stress is 6_b and the shear stress is 'τ'. If the principal stresses at the point are 60 MPa tensile and 20 MPa compressive, find the values of 6_b and τ. Also find the value of maximum shear stress.

c) Define Resilience and proof resilience. 8

Solve : A vertical round steel rod, 1.82 m long is securely held at its upper end and a weight sliding freely on the rod falls on to a stop at the lower end of the rod. When the weight falls from a height of 30 mm the maximum stress reached in the rod is estimated to by 157 N/mm^2. Determine the stress if the load had been gradually applied and also the maximum stress if the load had fallen from a height of 45 mm.

Take E = 2×10^5 N/mm^2.

UNIT – III

3. a) Derive the relation between bending moment, shear force and intensities of loading. 8

b) Draw shear force diagram and bending moment diagram for the beam shown in fig. 2. Calculate the maximum bending moment and the point at which it acts. **8**

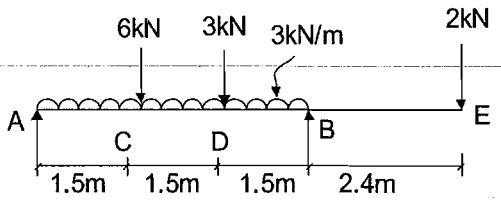

Fig.2

c) For a simply supported beam AB the shear force diagram is as shown in fig. 3. Draw bending moment diagram and load diagram for this beam. **8**

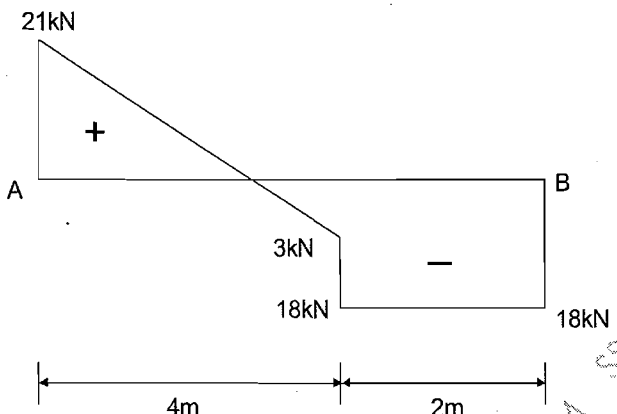

Fig.3

UNIT – IV

4. a) State the equation of bending and specify all terms used. **8**
Solve : A simply supported cast iron rectangular beam of length 800mm and 15 mm x 15 mm section fails on applying 360 N at mid span. Find maximum UDL that can be applied to cantilever made of same material 40 mm wide, 75 mm deep and 1.6 m long.

b) Explain Middle third rule. **8**
Solve : A rectangular column is 200 mm wide and 150 mm thick. It carries a load of 60 kN at an eccentricity of 20 mm in a plane bisecting the thickness. Find the maximum and minimum intensities of stress in the section.

c) A 'T' shaped cross-section of a beam shown in fig. 4 is subjected to a vertical shear force of 240 kN. Calculate the shear stress at the neutral axis and at the junction of the web and the flange. Moment of inertia about horizontal neutral axis is 53125000 mm^4. **8**

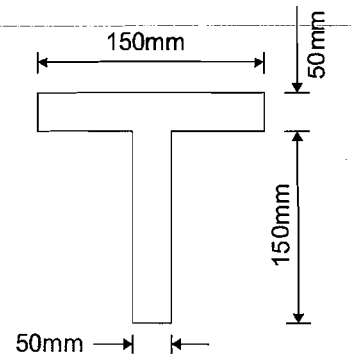

Fig.4

UNIT – V

5. a) Derive the equation of torsion for circular shaft. **8**

b) Define polar moment of Inertia & polar modulus. **8**
Solve : A solid shaft is of 100 mm diameter. It transmits 120 kw at 200 rpm. Find the maximum intensity of shear stress induced and the angle of twist for a length of 6m.
Take G = 8×10^4 N/mm^2.

c) State the assumptions made in Lame's Theory. **8**
Solve : A spherical shell of 120 mm internal diameter has to withstand an internal pressure of 30 MPa. If the permissible tensile stress is 80 MPa. Calculate thickness of the shell.

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चंदन - 007

Seat Number

* 2 1 4 7 *

Material Science & Metallurgy
(123104/213104)

P. Pages : 2

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Write **any two** sub-question from each question.
5. Draw neat and clean diagram wherever necessary.
6. Figures to right indicate full marks.

1. a) Explain edge dislocation and screw dislocation. **8**

b) What is cold working and hot working ? How hot working is superior than cold working ? **8**

c) Explain dispersion and precipitation hardening. **8**

2. a) Explain Impact test, Give types of notches ? and also differentiate between charpy and Izod test. **8**

b) Describe creep test in details. **8**

c) Write notes on :

i) Radiographic testing. **4**

ii) Eddy current testing. **4**

3. a) i) Draw Iron-Carbon equilibrium diagram. **4**

ii) Explain Non-equilibrium cooling. **4**

b) Write notes on :

i) White cast Iron. **4**

ii) Malleable cast Iron. **4**

c) Explain effects of various alloying elements on structure and properties of cost iron. **8**

4. a) Write notes on :
   i) Annealing. **4**
   ii) Tempering. **4**

   b) What is hardenability ? Explain in details Jominy End Quench Test. **8**

   c) Explain flame hardening and Induction hardening. **8**

5. a) Enlist different alloying elements. And explain effect of any three elements on steel. **8**

   b) What are tool steel ? Explain Heat treatment cycle of High speed tool steel. **8**

   c) Give classification of stainless steel and explain carbide precipitation. **8**

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चंदन - 008

Seat Number

* 2 1 4 8 *

Manufacturing Engineering - I
(123105 / 213105)

P. Pages : 3

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory.
5. Draw neat sketches wherever necessary.
6. Figures to right indicates full marks.

UNIT – I

1. Solve **any two.**

a) i) Define the following terms used in sand mould casting. **4**
   i) Core ii) Gates
   iii) Riser iv) Chaplets

   ii) Explain in brief gated pattern & match plate pattern. **4**

b) Explain in brief pattern materials & pattern allowances. **8**

c) i) Explain solidification process of casting. **4**

   ii) Explain working of induction furnace. **4**

UNIT – II

2. Solve **any two.**

a) i) Describe various types of rolling mills used in hot rolling. **4**

   ii) What is upset forging & how it is done. **4**

b) i) Describe hydrostatic extrusion & give its advantages. **4**

ii) Compare extrusion & rolling process. **4**

c) Describe wire drawing & rod drawing. **8**

UNIT – III

3. Solve **any two.**

a) i) Explain briefly various types of welding joints commonly used in welding. **4**

ii) Explain with sketch edge preparation to obtain sound welded joint. **4**

b) Describe with neat sketch Thermit welding with its merits & demerits. **8**

c) i) What is the principle of friction welding & resistance welding. **4**

ii) Explain the process of soldering & brazing. **4**

UNIT – IV

4. Solve **any two.**

a) i) How is centre lathe specified. **4**

ii) With the help of sketches show the following machining operations on lathe. **4**
a) Boring b) Facing
c) Drilling d) Knurling

b) i) Explain various milling operations & cutter used for them. **4**

ii) Draw a neat sketch & describe briefly following operation. **4**
a) Reaming b) Counter boring

c) i) What is dressing & Trueing of grinding wheels. **4**

ii) Define lapping & honing explain in brief types of lapping methods. **4**

UNIT – V

5. Solve **any two.**

a) Write short note on powder testing & evaluation. **8**

b) Explain the following powder metallurgy processes. **8**
   i) Blending
   ii) Compacting
   iii) Presentering
   iv) Sintering.

c) What are the advantage, disadvantages & limitations of powder metallurgy. **8**

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Seat Number

* 2 1 4 9 *

Fluid Mechanics
(123101 / 213101)

P. Pages : 3

Time: Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
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3. Students should note, no supplement will be provided.
4. All questions are compulsory. Solve **any two** sub question from each question.
5. Use of non programmable calculator is allowed.
6. Assume suitable data if necessary.

1. a) Derive an expression for the depth of center of pressure form free surface of liquid of an inclined plane surface sub-merged in the liquid. **8**

b) A circular plate 3.0 m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of plate and position of center of pressure. **8**

c) Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8m x 0.8m and an inclined plane with angle of inclination 30^0. The weight of square plate is 300N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5mm. **8**

2. a) Obtain an expression for continuity equation for a three dimensional flow for compressible fluid and incompressible fluid and for steady flow. **8**

b) A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10cm is used to measure the flow of water. The pressure at inlet is 17.658 N/cm^2 and the vacuum pressure at the throat is 30 cm of mercury. Find the discharge of water through venturi meter take Cd = 0.98. **8**

c) A pitot tube is inserted in a pipe of 300 mm diameter. The static pressure in pipe is 100mm of mercury (Vacuum). The stagnation pressure at the centre of the pipe, recorded by the pitot- tube is 0.981 N/cm^2. Calculate the rate of flow of water through pipe, if the mean velocity of flow is 0.85 times the central velocity. Take C_v= 0.98 **8**

3. a) A shaft is rotating in a journal bearing. The clearance between the shaft and the bearing is filled with a viscous oil. Find on expression for the power absorbed in overcoming viscous resistance. **8**

b) The external and internal diameters of a collar bearing are 200mm and 150mm respectively. Between the collar surface and the bearing an oil film of thickness 0.25 mm and of viscosity 0.9 poise is maintained. Find the torque and the power lost in overcoming the viscous resistance of the oil when the shaft is running at 250 r. p. m. **8**

c) Prove that Energy thickness for boundary layer flows are given by $\delta^{**} = \int_0^{\delta} \frac{u}{U}\left[1 - \frac{u^2}{U^2}\right] dy$ **8**

4. a) Find an expression for the η power transmission through pipes. What is the condition for maximum transmission of power and corresponding efficiency of transmission? **8**

b) A pipe line 60 cm diameter bifurcates at a Y- Junction into two branches 40 cm and 30 cm is diameter. If the rate of flow in the main pipe is 1.5 m^3/s and mean velocity of flow in 30cm diameter pipe is 7.5m/s determine the rate of flow in the 40 cm diameter pipe. **8**

c) An old water supply distribution pipe of 250mm diameter of a city is to be replaced by two parallel pipes of smaller equal diameter having equal lengths and identical friction factor values. Find out the new diameter required. **8**

5. a) How you classify the reciprocating pumps? Differential **8**
   i) Between a single-acting and double acting reciprocating pump.
   ii) Between a single cylind and double cylinder reciprocating pump.
   Also define slip and percentage slip of reciprocating pump.

   b) A three stage centrifugal pump has impellers 40cm in diameter and 2cm wide at outlet. The vanes are curved back at outlet at 45° and reduce the circumferential area by 10%. The manometric efficiency is 90% and the overall efficiently is 80%. Determine the head generated by the pump wren running at 1000 rpm delivering 50 liters per second. What should be the shaft horse power? **8**

   c) Define specific speed of centrifugal pump and derive an expression for specific speed of centrifugal pump. **8**

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चंदन - 010

Seat Number

* 2 1 5 0 *

Engineering Thermodynamics
(123102 / 213102)

P. Pages : 3

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
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3. Students should note, no supplement will be provided.
4. Attempt **any two** from bits a, b, c from each unit.
5. Draw neat sketches wherever necessary.
6. Assume suitable data, if necessary.
7. Black figures to the right indicate full marks.
8. Use of steam table, non programmable pocket calculator is allowed.

UNIT – I

1. a) Explain quasi-static process with an example. **8**

   b) "A system has reached an equilibrium state". What is its meaning ? **8**

   c) A spherical ballon contains 5 kg of air at 200 kPa and 500 k. The ballon material is such that the pressure inside is always proportional to the square of the diameter. Determine the work done, when the volume of the ballon doubles as a result of heat transfer. **8**

UNIT – II

2. a) Show that internal energy of an ideal gas is a function of temperature only by using Joule's experiment. **8**

   b) Apply SFEE to following. **8**

      i) Nozzle and Diffusers.

      ii) Steam and gas turbines.

iii) Centrifugal water pump.

iv) Boiler, Heat exchanger.

c) A certain water heater operates under steady flow conditions receiving 4.2 kg/s of water at 75°C temperature, enthalpy 313.93kJ/kg. The water is heated by mixing with steam which supplied to the heater at temp. 100.2°C and enthalpy 2676 kJ/kg. The mixture leaves the heater as liquid water at temperature 100°C and enthalpy 419 kJ/kg. How much steam must be supplied to the heater per hour ? **8**

UNIT – III

3. a) Compare heat engine, heat pump and refrigerator. **8**

b) Prove the claussius Inequality. **8**

c) It takes 15 kw to keep the interior of an auditorium at 22°C when the outside temp. is 2°C. The heat flow is obtained by burning oil. Calculate the power required if the 15 kw heat flow were supplied by operating a reversible heat pump with the theatre as the upper reservoir and the outside surrounding as the lower reservoir. **8**

i) Find the power required to drive the heat pump.

ii) Find the saving in power by using heat pump.

UNIT – IV

4. a) i) Derive characteristic gas equation. **4**

ii) Obtain an equation for heat transfer in polytrophic process in terms of polytrophic specific heat. **4**

b) The following equation, which connects u, p and v for several gases, **8**

u = a + bpv

where a and b are constants. Prove that for a reversible adiabatic process.

$pv^{\gamma} = \text{constant where } \gamma = \frac{b+1}{b}$

c) A cylinder contains 0.12 m^3 of air at 1 bar and 90°C. It is compressed 0.03 m^3. The final pressure being 6 bar. Find the index of compression, increase in internal energy and heat transferred. **8**

Take R = 0.287 kJ/kg k & $C_V = 0.717 \frac{kJ}{kgk}$.

UNIT – V

5. a) Give the phase change phenomenon of a pure substance. **8**

b) How you measure dryness fraction by using combined separating and throttling calorimeter ? **8**

c) Identify the type of steam in the following three cases using the steam table and giving necessary calculations supporting your claim. **8**

i) 2 kg of steam at 8 bar with enthalpy 5538.0 kJ at temperature 170.4°C.

ii) 1 kg of steam at 2550 kPa occupies a volume of 0.2742 m^3. Also find the steam temp.

iii) 1 kg of steam at 60 bar with enthalpy of 2470.73 kJ/kg.

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Seat Number

* 2 1 5 2 *

Industrial Engineering
(1100 / 1090 / 1080)

P. Pages : 2

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

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3. Students should note, no supplement will be provided.
4. All questions are compulsory.
5. Attempt **any two** sub question from each question.
6. Neat diagrams must be drawn wherever necessary.
7. Figures to right indicate full marks.

UNIT – I

1. a) State the contribution of F.W. Taylors and Gilberth towards the growth of Industrial engineering. **10**

b) i) Define work measurement and state its objectives. **5**

ii) Explain in brief the basic procedure of work measurement. **5**

c) Write a short note on the following. **10**
i) Flow process chart.
ii) Multiple activity chart.

UNIT – II

2. a) i) Define plant layout state the principle of plant layout. **5**

ii) Describe the process layout with a neat sketch. **5**

b) State & explain the guiding principles of material handling. **10**

c) i) Write a salient features of Indian boiler act. **5**

ii) Explain factory act, 1984 in brief. **5**

UNIT – III

3. a) State and explain the various external & internal factors affecting scheduling. **10**

   b) State and explain the objectives of short term and long time forecasting. **10**

   c) Write a short note on, **10**
      i) Plant capacity
      ii) Bar chart.

UNIT – IV

4. a) What is job evaluation ? State the various methods of job evaluation. Explain any two. **10**

   b) Explain 'Taylors differential piece rate system' and 'Halsey incentive plan' of incentive scheme along with merits & demerits. **10**

   c) i) What is value analysis ? State its objectives. **5**

      ii) Define value what are different types of values. **5**

UNIT – V

5. a) What is man – machine system ? Give the classification and explain types of man – machine system. **10**

   b) i) Give the requirement of good industrial seating. **5**

      ii) Write a short note on 'Ergonomics and safety'. **5**

   c) Define 'Anthropometry'. Describe the anthropometric principles in brief. **10**

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Seat Number

* 2 1 5 4 *

Theory of Machines - I
(1090 / 1080)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

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3. Students should note, no supplement will be provided.
4. All questions are compulsory, solve **any two** bits out of a, b, c in each question.
5. Assume suitable data if necessary.
6. Use of non-programmable Calculator is allowed.

1. a) i) What is steering gear mechanism? Derive the condition for correct steering. **5**

ii) What is inversion of kinematic chain? Explain Oldham's coupling. **5**

b) The mechanism shown in fig (1). The various dimensions are OA = 120 mm, AB = 500 mm, BC = 120 mm, CD = 300 mm and DE = 150 mm. The crank OA rotates at 150 RPM. CDE is the bell crank lever. Determine the absolute velocity of point E. **10**

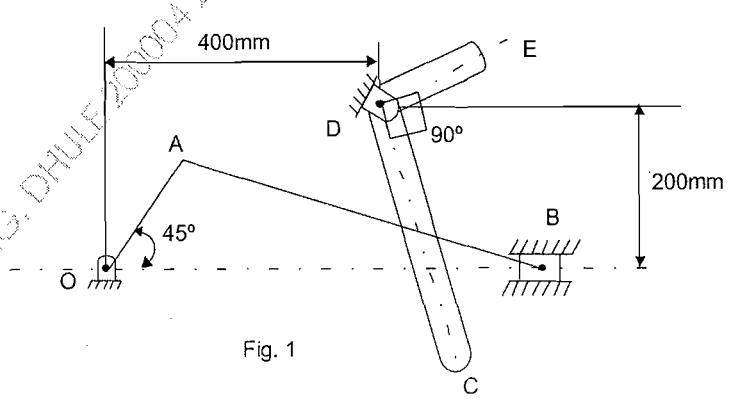

Fig. 1

c) An engine mechanism is shown in Fig. (2). The crank CB = 100 mm and the connecting rod BA = 300 mm with centre of gravity G, 100 mm from B. In the position shown, the crankshaft has a speed of 75 rad/s and angular acceleration of 1200 rad/s^2. Find: **10**

1) Velocity of G and angular velocity of AB.

2) acceleration of G and angular acceleration of AB.

2. a) Write short notes on. **10**

i) Dynamic equivalent system.

ii) Trifilar suspension system.

b) What is an equivalent length of compound pendulum? Derive an equation for frequency of compound pendulum. **10**

c) A connecting rod is suspended from a point 25 mm above the centre of small end, and 650 mm above its centre of gravity, its mass being 37.5 Kg. When permitted to oscillate, the time period is found to be 1.87 sec. Find the dynamical equivalent system constituted of two masses, one of which is located at the small end centre. **10**

3. a) Derive loop closure equation for four bar mechanism. **10**

b) In an IC engine mechanism Crank radius is 50 mm and connecting rod length 250 mm. Write loop closure equation when the crank is at 30° from IDC. **10**

c) Explain vector complex method for finding the velocity of piston in single slider mechanism. **10**

4. a) An applied force or effort of 1500 N is required to be able to move the body up with uniform velocity up an inclined plane of angle 12° with force acting parallel to the plane. With the inclined plane angle increased to 15°, the applied force increased to 1700 N. Determine the mass of the body and the coefficient of friction between the body and the surface of inclined plane. **10**

b) Prove that for maximum efficiency of screw jack using square threaded screw is given by **10**

$$\eta_{max} = \frac{1-\sin\phi}{1+\sin\phi}$$

c) The pitch of 50 mm. Mean diameter threaded screw of a screw jack is 12.5 mm. The Coefficient of friction between the screw and the nut is 0.15. Assuming the load to rotate with screw. Determine: **10**

i) the torque required on the screw to raise a load of 30 KN.

ii) the ratio of the torque required to raise the load to torque required to lower the load.

iii) the efficiency of the machine.

5. a) Prove that the maximum power transmitted, considering centrifugal tension is give by. **10**

$$P = \frac{2T}{3000}\left(1-\frac{1}{e^{\mu\theta}}\right)\times\left(\frac{T}{3m}\right)^{0.5} KW$$

where,
T= maximum permissible tension in belt (N).
m= mass of 1 m length of belt (Kg).
μ=coefficient of friction between belt & pulley.
θ= angle of contact of belt on pulley in radian.

b) Calculate the maximum power transmitted by an open belt drive embracing a pulley by 120°, if the maximum stress in the belt is not to exceed 1.4 N/mm^2. What is the corresponding linear speed of the belt? Particulars of the belt available are: width = 100 mm, thickness = 6 mm, ρ=0.97 gm/cm^3. Assume μ=0.3. **10**

c) Two parallel shafts connected by a cross belt drive have the diameters of pulleys 400 mm and 600 mm respectively. The direction of rotation of the driven shaft is required to be reversed, by changing over to an open belt drive. State if the same belt can be used. If not, what is the remedy? Assume that the centre between the shaft is fixed at 6 m. **10**

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Seat Number

* 2 1 5 5 *

Engineering Mathematics - III
(1010)

P. Pages : 4

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory.
5. Use of non-programmable electronic calculator is allowed.
6. Use of statistical tables is allowed.

1. Attempt **any four.** **20**

a) Solve $(D^2+2)y = e^{-2x} + \cos 3x + x^3 + x^2$

b) Solve $(D^2-4D+4)y = 8x^2e^{2x}\sin 2x$

c) $(D^2-2D)y = e^x \sin x$; solve by the method of variation of parameters.

d) $(D^2-1)y = (1+e^{-x})^2$

e) $x^2\frac{d^2y}{dx^2} + 5x\frac{dy}{dx} + 3y = \frac{\log x}{x^2}$

f) The differential equation for the displacement y of a whirling shaft when the weight of the shaft is taken into account is $EI\frac{d^4y}{dx^4} - \frac{Ww^2}{g}y = W$ taking the shaft of length '2ℓ' with the origin at the centre and short bearings at both ends, show that the maximum deflection of the shaft is $\frac{g}{2w^2}(\text{sechal} + \text{secal} - 2)$

2. Attempt **any two.**

a) i) Solve $\frac{dx}{dt}-\frac{dy}{dt}+2y=\cos 2t$ **7**

$\frac{dx}{dt}+\frac{dy}{dt}-2x=\sin 2t$

ii) Solve, $\frac{dx}{z^2y}=\frac{dy}{z^2x}=\frac{dz}{y^2x}$ **3**

b) If $\frac{\partial^2 y}{\partial t^2}=c^2\frac{\partial^2 y}{\partial x^2}$ represents the vibration of string of length 'ℓ' fixed at both ends, find the solution with boundary conditions ; **10**

i) $y(0\,t)=0$ ii) $y(\ell\,t)=0$

iii) $\left(\frac{\partial y}{\partial t}\right)_{t=0}=0$ iv) $y(x0)=k(\ell x-x^2);\ 0\le x\le \ell$

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

$u=20x$ for $0\le x\le 5$

$=20(10-x)$ for $5\le x\le 10$

and the two long edge x = 0, x = 10 as well as the other short edge are kept at 0°C, then find the temperature u at any point (x, y).

3. Attempt **any four.** **20**

a) Find $L\left[\int_0^t \frac{e^{-4t}\sin 3t\,dt}{t}\right]$

b) Find $L\left[\frac{\cos\sqrt{t}}{\sqrt{t}}\right]$

c) Evaluate $\int_0^\infty\left(\frac{1-\cos t}{t^2}\right)dt$

d) Find inverse Laplace Transform of ;

$$\frac{Se^{-\frac{s}{2}} + \pi e^{-s}}{S^2 + \pi^2}$$

e) Find inverse Laplace transform of ,

$$\frac{S+4}{S(S-1)(S^2+4)}$$

f) Using Laplace Transform solve the differential equation
$y'' - 4y' + 4y = 64 \sin zt$
given $y(0) = 0$; $y'(0) = 1$

4. Attempt **any two.**

a) i) From the following frequency distribution, compute the coefficient of variance. **5**

Marks	1 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60
No. of candidates	3	16	26	31	16	8

ii) Calculate the first four central moments for the following data. **5**

x	0	1	2	3	4	5	6
y	5	15	17	25	19	14	5

b) i) Find the coefficient of correlation between x and y from the given table. **5**

x	80	45	55	56	58	60	65	68	70	75	85
y	81	56	50	48	60	62	64	65	70	74	90

ii) Discuss the kurtosis of the following data. **5**

Class	0 - 10	10 - 20	20 - 30	30 - 40
f	1	3	4	2

c) i) The following regression equations and variances are obtained from a correlation table ; **6**
$20x - 9y - 107 = 0$; $4x - 5y + 33 = 0$
variance of x = 9 find :
i) the mean of x & y ii) the standard deviation of y.

ii) Write a note on Kurtosis. 4

5. Attempt **any two.**

a) i) The probability that a man aged 60 will live to be 70 is 0.65. What is the probability that out of 10 men, now 60, at least 7 will live to be 70 ? **5**

ii) Show that the Fourier transform of $f(x) = e^{-x^2/2}$ is $e^{-\lambda^2/2}$ **5**

b) i) Fit a Poission distribution to the following data. **5**

X_i	0	1	2	3	4
Observed frequencies f_i	30	62	46	10	2

ii) Find the Fourier sine transform of the following function : **5**

$$f(x) = \begin{cases} x & , \ 0 \le x \le 1 \\ 2-x & , \ 1 \le x \le 2 \\ 0 & , \ x > 2 \end{cases}$$

c) i) Pipes for tobacco are being packed in tancy plastic boxes. The length of the pipe is normally distributed with $\mu = 5''$ and $\sigma = 0.1''$. The internal length of the boxes is 5.2". What is the probability that the box would be small for the pipe. **5**

ii) Using inverse sine transform, find f(x) it **5**

$$F_s(\lambda) = \frac{1}{\lambda} e^{-a\lambda}$$

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Seat Number

* 2 1 5 6 *

Material Science
(1030)

P. Pages : 2

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Attempt all questions.
5. From each question attempt **any two** sub questions out of a,b,c.
6. Figures to the right indicates full marks.
7. Use of non programmable calculator is allowed.
8. Assume suitable data if necessary.

1. a) i) What is lattice parameter ? Determine the relationship between the atomic radius and lattice parameters in BCC and FCC structure. **6**

ii) Why FCC metals are in general more ductile than BCC and HCP metal. **4**

b) i) Differentiate between the following. **6**
1) Ship and Twining.
2) Plastic deformation of single crystal and polycrystalline material.

ii) Show that atomic packing factor for FCC crystal structure is 0.74. **4**

c) i) Differentiate between **6**
1) Ceramics and composites.
2) Metal matrix composites & fiber reinforced composite.

ii) Explain plastic elastomers and list the applications of the same. **4**

2. a) What is notch sensitivity ? Explain charpy Impact test and Izod Impact test. **10**

b) i) What do you understand by creep in metals ? Draw a typical creep curve and explain various stages in creep. **6**

ii) List various NDT test and explain dye penetrant test. **4**

c) i) Draw neat and self explanatory sketches of the following. **6**

1) Ductile and Brittle factures.

2) Stress strain curve for mild steel, cast iron and copper.

ii) Explain Magma flax testing method. **4**

3. a) i) What are various strengthening mechanisms. Explain Dispersion Hardening in detail. **6**

ii) Explain solation Hardening treatment. **4**

b) Draw typical eutectic system diagram and explain it's important features with suitable example of system. **10**

c) What is coring ? Explain why it is not desirable and also explain the various methods of eliminating coring. **10**

4. a) Enumerate the various methods of powder manufacturing ? Describe any two of them. **10**

b) Explain pyrometry ? List various methods of measuring temperature and explain Resistance pyrometer with sketch. **10**

c) i) Define the following. **6**

1) Tap density.

2) Apparent density.

3) Green density.

ii) What is conditioning of metal powders ? Why it is done ? **4**

5. a) i) What is oxide film? Explain its formation and growth mechanism. **6**

ii) List various methods of corrosion control. Explain any one of them in details. **4**

b) i) Why is season cracking a major problem in brass component? **6**

ii) Explain Physical Vapour Deposition (PVD) in brief. **4**

c) What is inhibitor? Classify them and explain with applications. **10**

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Seat Number

* 2 1 5 7 *

Strength of Materials
(1020)

P. Pages : 4

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

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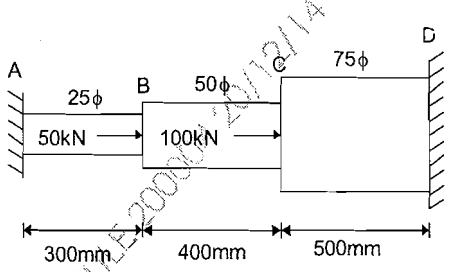
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Attempt complete question at one place only.
5. All questions are compulsory and solve **any two** bits from a, b, c in each question.
6. Assume suitable data if necessary.
5. Use of non programmable calculator is allowed.

UNIT – I

1. a) i) Define factor of safety **2**

ii) A circular steel bar ABCD rigidly fixed at A & D is subjected to axial loads of 50KN and 100 KN at B & C as shown in fig. **8**



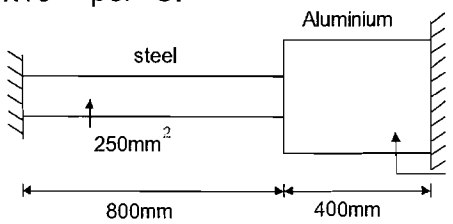
Find the loads shared by each part of the bar and displacements of the points B & C. Take E for steel as 200 G.pa.

b) i) Define Bulk modulus. **2**

ii) A bar of 30 mm diameter is subjected to a pull of 60KN. The measured extension on gauge length of 200 mm is 0.1mm and change in diameter is 0.004mm. Calculate. i) Young modulus ii) Poisson's ratio and iii) Bulk modulus. **8**

c) i) Explain temperature stresses and temperature strains . **2**

ii) A composite bar consisting of steel and aluminum components as shown is connected to two grips at the ends at a temperature of 60^0C. Find the stresses in the two rods when the temperature falls to 20^0C. i) If ends do not yield ii) If ends yield by 0.25mm. Take $E_s = 2 \times 10^5$ N/mm^2, Ea= 0.70×10^5 N/mm^2, $\alpha_s = 1.17 \times 10^{-5}$ per ^{0}C and $\alpha_a = 2.34 \times 10^{-5}$ per ^{0}C. **8**



UNIT – II

2. a) i) Define principle stresses . **2**

ii) At a point in a strained material, the principle stresses are 100 N/mm^2 (tensile) and 60 N/mm^2 (compressive). Determine the normal stress, shear stress and resultant stress on a plane inclined at 50^0 to the axis of major principal stress. Also determine the maximum shear stress at the point. **8**

b) i) Explain proof resilience and modulus of resilience. **2**

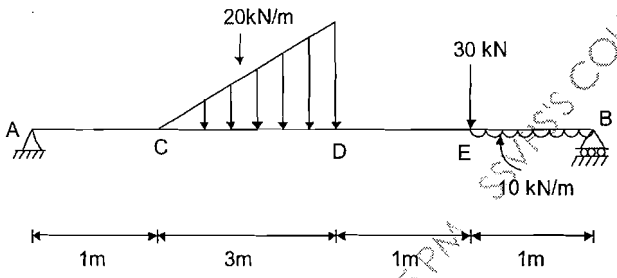
ii) An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence determine the magnitude and directions of principal stresses and also the greatest shear stress. **8**

c) i) A solid vertical prismatic steel bar of equilateral triangular section of side 20 mm is firmly fixed at the top. A rigid collar is attached at the lower end at a distance of 600 mm from the top. Calculate the strain energy stored in each of the following cases. **10**

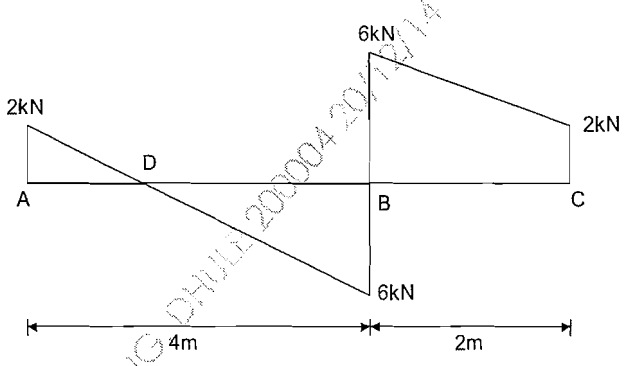
a) When a pull of 10 KN applied gradually.
b) When a force of 8 KN is suddenly applied
c) When a weight of 4 KN falls through 120 mm before it strikes the collar.
E=200 G.pa.

UNIT – III

3. a) Draw the shear force and bending moment diagram for a beam given below. **10**



b) From a given shear force diagram develop the beam loading diagram and draw bending moment diagram. **10**



c) A cantilever of length 2 meters carries a uniformly distributed load of 2500 N/m for a length of 1.25 m. From the fixed end and a point load of 1000 N at the free end. It the section is rectangular 120 mm side and 240 mm deep, find the deflection at free end. Take E= 10,000 N/mm^2. **10**

UNIT – IV

4. a) Derive shear stress distribution formula. **10**

b) A timber beam of rectangular section is to support a load of 20 KN uniformly distributed over a span of 3.6m when beam is simply supported. If the depth of section is to be twice the breadth and stress in the timber is not to exceed 7 N/mm^2 Find the dimension of the cross section. **10**

c) A column is rectangular in cross section of 300mm x 400mm in dimensions. The column carries an eccentric point load of 360 KN on one diagonal at a distance of quarter diagonal length from a corner. Calculate the stresses at all four corners. Draw stress distribution diagram for any two adjacent sides. **10**

UNIT – V

5. a) Derive the lame's equation for thick cylindrical shell. **10**

b) A thin cylindrical steel vessel has hemispherical ends. Overall length of vessel is 550mm. The outer diameter of the cylinder is 100 mm with thickness of metal 5mm. Calculate the change in the volume of vessel, when it is subjected to on internal pressure of 15 MPa. Take E= 200 G.pa and μ= 0.3. **10**

c) A hollow circular shaft has an external diameter of 120mm and an internal diameter of 100mm. The maximum permissible shear stress is 100 MPa and twist is not to exceed 3.6^0 in length of 3m. Maximum torque is 25% more than the average torque. The shaft is rotating at 2 revolutions/sec. Find the safe power that can be transmitted. Take G= 80 G.pa. **10**

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Seat Number

* 2 1 5 9 *

Manufacturing Engineering - I

(1040)

P. Pages : 2

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Solve **any two** from each question.
5. Draw neat sketches wherever necessary.
6. Figures to the right indicates full marks.

UNIT – I

1. a) Write short notes on the following. Giving suitable sketches. **10**

i) Cope and drag pattern ii) Gated pattern.
iii) Segmental pattern. iv) Solid pattern
v) Follow board pattern.

b) What is core? How many types of cores are there? Explain them with the help of sketches. **10**

c) Explain following casting processes with neat sketches. **10**
i) Continuous Casting.
ii) Centrifugal Casting

UNIT – II

2. a) Explain with neat sketch machine forging & cold forging. **10**

b) What is principle of operation in Rolling process? With the help of neat sketch explain process of rolling tubes. **10**

c) Describe with neat sketch wire drawing. **10**

UNIT – III

3. a) What is welding? Sketch & explain the following welding processes. **10**
   i) Friction welding. ii) Submerged arc welding.

   b) Draw a neat sketch of Electric arc welding & explain it. Differentiate between A. C. & D. C. welding. **10**

   c) What is welding defects? Name welding defects, their causes & remedies. **10**

UNIT – IV

4. a) Explain the following in brief gear manufactured by – **10**
   1) Casting 2) Roll forming.

   b) Why gear finishing is required? Describe varies gear finishing operations. **10**

   c) Explain the threads are manufactured by casting & thread rolling processes. **10**

UNIT – V

5. a) Describe the various work holding equipment used on a turret lathe. **10**

   b) i) Describe with neat sketch automatic indexing on turret lathe. **5**
   ii) State the difference between capstan & turret lathe. **5**

   c) Describe different types of multi spindle automatic machine. **10**

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Seat Number

* 2 1 6 0 *

Applied Thermodynamics
(1050)

P. Pages : 4

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory.
5. Attempt **any two** subquestion from each question out of a,b,c.
6. Figures to the right indicate full marks.
7. Use of Mollier charts, steam table and non programmable calculator is allowed.
8. Assume suitable data if necessary.

UNIT – I

1. a) Explain the procedure of determination of calorific value of a gaseous fuel by a Junker's gas calorimeter. **10**

b) C_2H_6 burns completely with air when the air-fuel ratio is 18 on mass basis. Determine the percent excess or percent deficiency of air as appropriate and the dew point temperature of combustion products when cooled at 1 atm. **10**

c) During production of gas the air and steam are passed through an incandescent coal bed. The coal is seen to have 95% of carbon and remaining as incombustible. The gas produced has hydrogen, nitrogen and carbon monoxide. Determine, the steam required per kg of coal and total air required per kg of coal when the heat of formation for steam is 147972 kJ/kg of hydrogen and for carbon monoxide it is 10324 kJ/kg of carbon. Also obtain volumetric analysis of gas. Take temperature of water as 20°C at 1 atm pressure. Take air to have 23.2% O_2, and 76.8% N_2 by mass. **10**

UNIT – II

2. a) Prove that the draught produced, in mm of water by a chimney is given by $h = 353\,H\left[\frac{1}{Ta} - \frac{1}{Tg}\left(\frac{ma+1}{ma}\right)\right]$. **10**

b) Draw up a heat balance sheet for the boiler in kJ per kg of dry coal and also determine the boiler efficiency and effectiveness of air heater for the following data obtained during boiler trial. The boiler has economiser and air preheater as two accessories in it. **10**

Atmospheric air temperature : 15°C
Steam generation : 40 bar, 400°C
Steam generated per kg of coal = 8 kg
Feed water temperature at inlet to economiser = 27°C
Feed water temperature at exit of economiser = 137°C
Moisture in coal burnt = 1.5%
Flue gas temperature entering air heater = 300°C
Flue gas temperature leaving air heater and entering chimney = 150°C
Temperature of air entering boiler furnance = 120°C
Dry coal composition by mass = 84%C, 4%H_2, 7%O_2 and reminder ash.
Dry flue gas composition by volume = 12.5%CO_2, 7.5%O_2, 80%N_2
Datum temperature = 15°C
Colorific value of coal = 32600 kJ/kg
For air and dry flue gas, CP = 1.0032 kJ/kg.K
Partial pressure of vapour in flue gas = 0.075 bar
Specific pressure of vapour = 2.0064 kJ/kg.K

Determine the boiler efficiency and the efficiency of heat exchange in air heater. Also prepare heat balance sheet in kJ per kg of dry coal.

c) A steam generator delivers steam at 100 bar, 500°C (enthalpy, h=3373.7 kJ/kg). The feed water inlet temperature is 160°C (h=677 kJ/kg). The enthalpies of saturated liquid and saturated vapour at 100 bar are 1407.65 and 2724.7 kJ/kg respectively. The steam generation rate is 100000 kg/h and the steam generation efficiency is 88%. **10**

Estimate :

i) The fuel burning rate is kg/h, if calorific value of fuel is 21 mJ/kg;
ii) The percentage of total heat absorbed in the economiser, evaporator and superheater.

Assume that only latent heat is absorbed in the evaporator and neglect any pressure drop.

UNIT – III

3. a) What are the reasons for inefficiency in surface condenser ? **10**

b) A steam power plant works on regenerative cycle with steam entering first turbine stage at 150 bar, 500°C and getting expanded in three subsequent stages up to the condenser pressure of 0.05 bar some steam is bled out between first and second stage for feed heating in closed feed water heater at 10 bar with the saturated liquid condensate being pumped ahead into the boiler feed water line. Feed water leaves closed feed water heater at 150 bar, 150°C steam is also taken out between second and third stages at 1.5 bar for being fed in to an open feed water heater working at that pressure. Saturated liquid at 1.5 bar leaves open feed water heater for being sent to closed feed water heater considering mass flow rate of 300 kg/s in to the first stage of turbine determine cycle thermal efficiency and net power developed in kw. Also give layout and T-S representation. **10**

c) A steam power plant use steam as working fluid and operates at a boiler pressure of 5 MPa, dry saturated and a condenser pressure of 5 KPa, Determine – **10**

i) carnot cycle.
ii) Rankine cycle.
iii) Enthalpy at the end of expansion.
iv) Net work done.
v) Work ratio.

UNIT – IV

4. a) Prove that maximum discharge in a steam nozzle per unit area at the throat is given by $M_{max} = \left[1000 \times \frac{p_1}{v_1}\left(\frac{2}{n+1}\right)^{\frac{n+1}{n-1}}\right]^{1/2}$ **10**

b) A steam turbine develops 190 kw with a consumption of 18 kg/kw.h. The pressure and temperature of steam entering the nozzle are 11.8 bar and 220°C, respectively. The steam leaves the nozzles at 1.18 bar, The diameter of nozzle at throat is 8mm find the number of nozzles. If 8 percent of the total enthalpy drop is lost in friction in diverging part of nozzle, determine the diameter at the exit of the nozzle and exit velocity of leaving steam. **10**

c) Derive an expression for the mass of steam discharged through a nozzle and condition for maximum value. **10**

UNIT – V

5. a) A single acting two stage air compressor delivers air at 18 bar. The temperature and pressure of the air before the compression in L.P. cylinder are 25°C and 1 bar. The discharge pressure of L.P. cylinder is 4.2 bar. The pressure of air leaving the intercooler is 4 bar and the air is cooled to 25°C. The diameter and stroke of L.P. cylinder are 40 cm and 50 cm respectively. The clearance volume is 5% stroke in both cylinders. The speed of the compressor is 200 r.p.m. Assuming the index of compression and re-expansion in both cylinders as 1.25, C_P for air = 1.004 kJ/kg.K, find : **10**

i) Power required to run the compressor, and
ii) Heat rejected in intercooler / min.

b) A multistage air compressor is to be designed to elevate the pressure from 1 bar to 125 bar such that stage pressure ratio will not exceed 4. **10**

Determine :

i) Number of stages.
ii) Exact stage pressure ratio.
iii) Intermediate pressures.

c) Derive the equation of condition for minimum work per kg of air delivered by two stage compressor with perfect intercooling. Also derive the equation of minimum work for multistage compression. For both derivation assume no clearance volume. **10**

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b) Describe with sketches compensating devices that are incorporated in main metering system as compensating Jet, air bleeding device and back suction control. **10**

c) Describe with the help of suitable sketches. **10**
i) Jerk pump system
ii) Common rail system
iii) Distributor system.

UNIT – III

3. a) Discuss important functions of the lubricating system. What is the significance of flash and fire points of lubricant? **10**

b) What do you understand by ignition timing? Discuss the various factors which affect ignition timing requirements. **10**

c) Why cooling of an internal combustion engine is necessary? What would happen if engine temperature is 50°C? **10**

UNIT – IV

4. a) What is ignition lag? Discuss the effect of engine variables on ignition lag. **10**

b) Describe the phenomenon of detonation or knocking is SI engine. Discuss the ill effects of detonation. **10**

c) What is HUCR? What is octane number? How octane number is found? What is RON and MON? **10**

UNIT – V

5. a) A 6 Cylinder petrol engine operates on the four stroke cycle. The bore of each cylinder is 70 mm and the stroke is 100 mm. The clearance volume per cylinder is 67 cm^3 At a speed of 3960 rpm the fuel consumption is 19.5 kg/h and torque developed is 140 N.M calculate a) Break power b) Brake mean effective pressure c) Break thermal efficiency if calorific value is 44 MJ/kg d) Relative efficiency on break power basis assume that the engine works on constant volume cycle. Take V=1.4 **10**

b) What is the cause of formation of CO and NOX? What is the effect of air fuel ratio on CO and NOX emission? What is the effect of spark advance on NOX emission? **10**

c) Name four different methods for measurement of engine friction power. Describe Willans line method? To which types of engine it is applicable what is the accuracy of this method. **10**

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Seat Number

* 2 1 0 4 *

Internal Combustion Engine
(1050)

P. Pages : 2

Time: Three Hours **Max. Marks : 100**

Instructions to Candidates :

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2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Attempt complete question at one place only.
5. All questions are compulsory and solve **any two** bits out of a, b, c, in each question.
6. Assume suitable data if necessary.

UNIT – I

1. a) Sketch the Otto cycle on P-V & T-S diagram? Obtain an expression for the air standard efficiency. Hence show that the efficiency of Otto cycle is lower than that of Carnot cycle? **10**

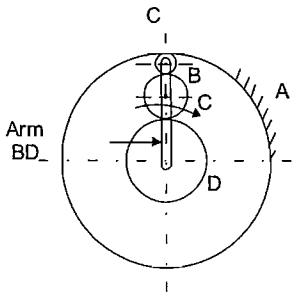
   b) An engine works on air standard Diesel cycle whose compression ratio is 14. The pressure and temperature at the beginning of the cycle are 1 bar and 300k respectively The maximum temperature of cycle is limited to 2500°C Determine thermal efficiency and mean effective pressure of cycle. **10**

   c) Sketch the stirling cycle on P-V and T-S diagrams. Compare carnot, stirling and Ericsson cycles operating between the same source and sink temperatures and with equal changes in specific volume. **10**

UNIT – II

2. a) Why rich mixture is required for idling and for maximum power? What are the mixture requirements for starting, warmup and acceleration? **10**

c) An epicyclic gear train is composed of a fixed annular wheel A having 150 teeth. Meshing with A is a wheel B which drives wheel D through an idle wheel C. D being concentric with A wheels B and C are carried on an arm which revolves clockwise at 100 rpm about the axis of A and D. If the wheels B and D have 25 and 40 teeth respectively. Find the number of teeth on C and speed and sense of rotation of **10**



UNIT – V

5. a) Four masses A, B, C & D are completely balanced. Masses C & D makes an angle of 90° & 195° respectively with that of mass B in the counter clockwise direction. The rotating masses have the following properties. **10**

m_b = 25 kg r_a = 150 mm
m_c = 40 kg r_b = 200 mm
m_d = 35 kg r_c = 100 mm
r_d = 180 mm

Planes B & C are 250 mm apart determine the
i) mass A & its angular position with that of mass B.
ii) positions of all planes relative to plane of mass A.

b) Explain in brief : **10**

i) Static balancing machine.

ii) Dynamic balancing machine.

c) Write short note on : **10**

i) Swaying couple.

ii) Hammer Blow.

****

UNIT – III

3. a) All the arms of a porter Governor are 178 mm long and are hinged at a distance of 38 mm from the axis of rotation. The mass of each ball is 1.15 kg and mass of sleeve is 20 kg. The Governor sleeve begins to rise at 280 rpm. When the links are at an angle of 30° to the vertical. Assuming the friction to be constant determine the minimum and maximum speed of rotation when the inclination of the arms to the vertical is 45°. **10**

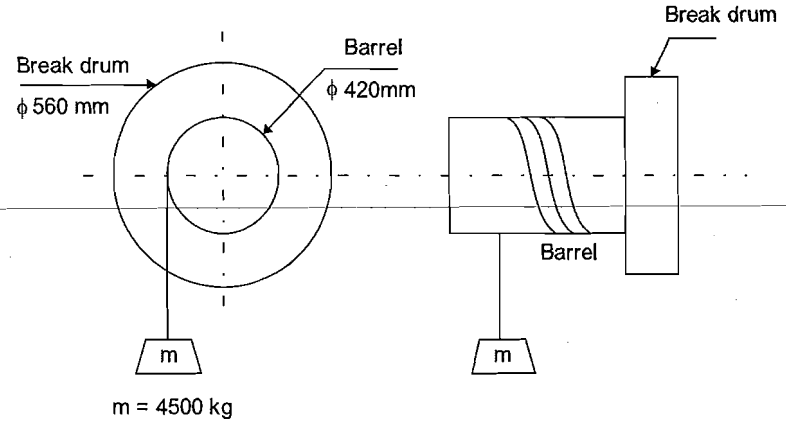
b) Explain the effect of gyroscopic couple on aeroplane. **10**

c) Find the angle of inclination with respect to the vertical of a two wheeler negotiating a turn given – combined mass of the vehicle with its rider 250 kg. Moment of Inertia of the engine flywheel 0.3 $kg.m^2$. Moment of inertia of each road wheel 1 $kg.m^2$. Speed of engine flywheel 5 times that of road wheels and in the same direction. Height of centre of gravity of rider with vehicle 0.6 m. Two wheeler speed 90 km/hr. Wheel radius 300mm. Radius of turn 50 m. **10**

UNIT – IV

4. a) A three start worm has pitch diameter of 80 mm & pitch of 20 mm.It rotates at 750 rpm & drives a 40 tooth worm gear. If coefficient of friction is 0.06 find : **10**
   i) The helix angle of worm.
   ii) The speed of gear.
   iii) The centre distance
   iv) Efficiency .
   v) The lead angle for maximum efficiency.
   vi) Maximum efficiency.

b) Explain following term : **10**
   i) Arc of contact.
   ii) Path of contact.
   iii) Number of pairs of teeth in contact.
   iv) Interference in involute gears.
   v) Minimum number of teeth.



c) Explain the construction & working of – **10**

i) Belt Transmission Dynamometer.

ii) Epicyclic train dynamometer.

UNIT – II

2. a) Draw a cam profile to drive an oscillating roller follower to the specification given below. **10**

i) Follower to move outwards through an angular displacement of 20° during the first 120° rotation of the cam.

ii) Follower to return to its initial position during next 120° rotation of the cam.

iii) Follower to Owell during the next 120° of cam roation.

The distance between pivot centre and roller centre = 120 mm, distance between pivot centre and cam axis = 130 mm. Minimum radius of cam = 40 mm radius of roller = 10 mm.

Inward and outward strokes takes place with simple harmonic motion.

b) Explain the terms as applied to the flywheel – **10**

i) Fluctuation of energy

ii) maximum fluctuation of energy.

iii) Coefficient of fluctuation of energy.

iv) Coefficient of fluctuation of speed.

c) A punching press is required to punch 40 mm diameter holes in plate of 15 mm thickness at the rate of 30 holes per minute. It requires 6 Nm of energy per mm^2. of sheared area. If the punching takes 1/10 of a second & the rpm of the flywheel varies from 160 to 140 determine the mass of the flywheel having radius of gyration 1 metre. **10**

चंदन - 059

Seat Number

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Theory of Machine - II
(1040)

P. Pages : 4

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

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2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
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4. All question are compulsory & Attempt **any two** bits out of a, b, c from each question.
5. Non programmable calculator is allowed.
6. Assume suitable data if necessary.

UNIT – I

1. a) A band and block brake having 14 blocks each of which subtends an angle of 14° at the center is applied to a drum of 900 mm effective diameter. The drum and the flywheel mounted on the same shaft weigh's 20 kN and has a combined radius of gyration as 600 mm. The two ends of the band are attached to pins on opposite sides and the brake lever fulcrum at distances of 40 mm and 160 mm from fulcrum. The coefficient of friction between block and drum is 0.3. Find out the minimum force required to applied at the end of the brake lever at a distance of 600 mm from the fulcrum to bring the system to rest from rated of 350 rpm in 8 seconds. **10**

b) The rope of a winch crab supports a dead weight of 4500 kg mass and is wound round a barrel of 420 mm diameter. A brake drum of 560 mm diameter is keyed to the barrel shaft. A differential band brake acts on the drum with its two ends attached to pins on opposite sides of the fulcrum of the block at 25 mm and 125 mm respectively. The band embraces 70% of the circumference of the drum. The coefficient of friction is 0.28. Find the least force required to be applied at the end of the brake lever 1 m from the fulcrum. **10**

diagram on next page

Property	Water	Acid
Density (kg/m^3)	998	1800
Thermal conductivity (w/mk)	0.6	0.3
sp. heat (J/kgk)	4187	1465
Kinematic viscosity (m^2/s)	1×10^{-6}	6.8×10^{-6}
Fouling factor (m^2k/w)	--	0.0002

Use following Relation

$Nu = 0.023 (Re)^{0.8}(Pr)^{0.3}$.

c) A steam condenser is transferring 250 kw of thermal energy at a condensing temperature of 65°C the cooling water enters the condenser at 20°C with a flow rate of 7500 kg/hr. Calculate the log mean temperature difference. If overall heat transfer coefficient for the condenser surface is 1250 w/m^2 °C. What surface area is required to handle this load ? What error would be introduced if the arithmetic mean temperature difference is used rather than the log mean temperature difference ? **10**

5. a) i) State and explain the different modes of mass transfer. **6**

ii) State Fick's law of diffusion. **4**

b) Show that the total mass of water vapour diffused from a water column to the air passing over the water container is given by **10**

$$(Mw)_{total} = \frac{DA}{GT}\frac{Mw\ Pt}{(x_2 - x_1)}\log_e\left[\frac{Pt - Pw_2}{Pt - Pw_1}\right].$$

c) The air pressure in a tyre tube of surface area $0.5m^2$ and wall thickness of 0.01m is approximated to drop from 2 bar to 1.99 bar in a period of 5 days the solubility of air in rubber is 0.07 m^3 of air/m^3 of rubber at 1 bar. **10**

Estimate the diffusivity of air in rubber at the operating temperature of 300K. If the volume of air in the tube is 0.025 m^3.

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b) A 3.5 KW plate heater of 15cm x 30 cm is held vertically with larger side vertical in a water bath at 40^0C. Make calculations for the steady state temperature attained by the heater if heat transfer is only due to convection. **10**
Use the following correlation.
$Nu = 0.13(Gr.pr)^{0.33}$ and take $\beta = 4.15x10^{-4}$ per deg^0 C
thermo physical properties of water are
ρ =977.8 Kg/m^3, Cp = 4.187 KJ/KgK, $\nu = 0.415 \times 10^6$ m^2/s,
K = 0.667 w/mk.

c) The wall of a tube 4m long and 20mm diameter is held at constant temperature providing a steam jacket. A viscous fluid enters the tube at 30°C and leaves at 40°C at the rate of 180 kg/hr. Determine the average heat transfer coefficient and the wall temperature. Use the following correlation. **10**

$$Nu = 3.65 + \frac{0.67\frac{d}{\ell} Re.Pr}{1+0.004\left[\frac{d}{\ell} Re.Pr\right]^{0.67}}$$

and take the following thermo-physical properties:
ρ=850 kg/m^3, K=0.1396 w/m°C, C_P=2000 J/kgk,
D=5.1x10^{-6} m^2/s.

4. a) i) What is mean by fouling factor ? How does it affect the performance of a heat exchanger ? **6**

ii) Define : overall heat transfer coefficient and effectiveness of heat exchanger. **4**

b) A chemical industry operates continuously and produces $2x10^5$ kg of sulphuric acid per day which needs to be cooled from 60°C to 40°C in a counter flow double pipe heat exchanger the acid flows through the inner pipe, while water employed as cooling medium flows through the annulus with temperature 15°C at entry and 20°C at exit the inner diameter for the inner and outer pipe are 70mm and 120mm respectively, and each pipe is 5mm thick presuming that thermal conductivity of inner pipe material is 48 w/mk, make calculation for the mass flow rate of water and length of the heat exchanger. **10**

c) The shell of an experimental boiling water reactor is cylindrical having inside radius 1m length 1.25 m & 10 cm wall thickness. The shell is made from alloy steel and a concrete wall 50 cm thick surround it The thermal conductivities of alloy steel and concrete are 22.5 W/m°C and 1.12 W/m°C respectively. The reactor operates at a power level of 6 KW of which 4 % is lost in heat transfer through the shell. If the inside water is at 150°C. Workout the interface temperature (temperature on the inside and outside of concrete covering) Neglect any resistance to heat flow between water and steel. **10**

2. a) i) Derive the governing differential equation for temperature distribution of constant are extended surface in the following form $\frac{d^2\theta}{dx^2} - m^2\theta = 0$ **6**

ii) Explain radiation shield. **4**

b) Consider radiative heat transfer between two large parallel planes of surface emissivity 0.8. How many thin radiation shield of emissivity 0.05 be placed between the surfaces to reduce the radiation heat transfer by a factor of 75? **10**

c) A horizontal steel shaft, 30mm diameter and 600mm long has its first bearing located 100mm form the end connected to the impeller of a centrifugal pump. If the impeller is immersed in a hot liquid metal at 500°C, Work out the temperature at the bearing under the condition. **10**

i) The shaft is vary long.
ii) The heat flow through the end of the shaft is negligible and
iii) The heat is transferred to the surrounding from the end.

The temperature and convection coefficient associated with the fluid adjoining the shaft are 35°C and 68 KJ/m²hr. °C for steel shaft, thermal conductivity =75 KJ/mhr deg.

3. a) i) Give a general equation for the rate of heat transfer by convection and hence define the coefficient of heat transfer. List the various factors on which the value of this coefficient depends. **6**

ii) What is a dimensionless number? How and why are they used in heat transfer? **4**

Seat Number

* 2 1 0 1 *

Heat & Mass Transfer
(1010)

P. Pages : 4

Time : Three Hours **Max. Marks : 100**

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4. All question are compulsory and attempt any two sub questions from each question.
5. Figure to the right indicate full marks.
6. Heat transfer data book is allowed.
6. Non programmable calculator is allowed and assume suitable data if necessary.

1. a) i) Define thermal conductivity, thermal resistance and thermal conductance. What is the approximates range of thermal conductivity of solids, liquids & gases? **6**

ii) Write the Fourier rate equation for heat transfer by conduction. Give the physical significance of each term. **4**

b) A spherical verssel of 0.5m outside diameter is insulatied with 0.2m thickness of insulation of thermal conductivity 0.04 W/m-deg. The surface temperature of the vessel is 195°C and out side air is at 10°C Determine. **10**

i) Heat flow.

ii) Heat flow per m^2 based on inside and out side area.

iii) Temperature gradients at the inner and outer surface.

c) Solve the following system of equations by Gauss Jordan method. **10**

$$5x - 2y + 3z = 18$$
$$x + 7y - 3z = -22$$
$$2x - y + 6z = 22$$

UNIT - V

5. a) Explain different steps of finite element analysis in detail? **10**

b) Using crank - Nicolson method solve. **10**
$u_{xx} = u_t$ subject to
u (x, 0) = 0 ; u (0,t) = 0 ; u (1, t) = t
taking $h = \frac{1}{4}$ and $k = \frac{1}{8}$
compute u for one time step only.

c) Explain in detail FEM and FDM. **10**

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b) The velocity V of a particle at a distance S from a point on its path is given by following table. **10**

S in meters	0	10	20	30	40	50	60
V in m / Sec	47	58	64	65	61	52	38

Estimate the time taken to travel 60 meters by using Simpson's one third method.

c) Using Taylor's series method find y at x = 1·1 and 1·2 by solving **10**

$\frac{dy}{dx} = x^2 + y^2$ given y (1) = 2·3

UNIT - III

3. a) Using Lagrange's formula for Interpolation find y (9.5) given **10**

X	7	8	9	10
Y	3	1	1	9

b) The population of town is as follows. **10**

Year X	1941	1951	1961	1971	1981	1991
Population in lakhs Y	20	24	29	36	46	51

Estimate the population increase during the period 1946 to 1976 using Newton's forward and Newton's backward formula.

c) Apply stirling formula to find y (25) for the following data. **10**

X	20	24	28	32
Y	2854	3162	3544	3992

UNIT - IV

4. a) Solve the equations **10**

$2x + 3y + z = 9$

$x + 2y + 3z = 6$

$3x + y + 2z = 8$

by LU decomposition method

b) Solve by Gauss Elimination method **10**

$3x + 4y + 5z = 18$

$2x - y + 8z = 13$

$5x - 2y + 7z = 20$

Seat Number

* 2 1 0 0 *

Numerical Analysis & Computational Methods
(1030)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

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5. Use of Non-programmable calculator is allowed.
6. Assume suitable data, if necessary.
7. Black figures to indicate full marks.

UNIT - I

1. a) Why error in computation is necessary? Explain different errors in numerical computation? **10**

b) Find the positive root between 1 and 2 which satisfies $x^3 - 3x + 1 = 0$ upto three decimal places using Horner's method **10**

c) Solve the equation $x\tan x = -1$ by Regula Falsi method starting with a = 2.5 and b = 3 correct to three decimal places. **10**

UNIT - II

2. a) Using Runge Kutta method of fourth order solve. **10**

$$\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$$

Given $y(0) = 1$ at $x = 0.2, 0.4$

UNIT V

5. a) Explain. **10**

   i) Design and Natural Tolerances.

   ii) Notch sensitivity.

   b) Explain. **10**

   i) Modified Goodman diagram.

   ii) Mechanical Reliability & factor of safety.

   c) Explain. **10**

   i) Design for finite and infite life.

   ii) fatigue design of components under combined stresses.

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