MECH

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 30258

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third/Fourth Semester

Mechanical Engineering

ME 3491 — THEORY OF MACHINES

(Common to Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Agricultural Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

(Permitted : A3 drawing sheet)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Differentiate between lower pair and higher pair.

2. Name the two methods of finding acceleration in a mechanism.

3. Two mating spur gears have 74 and 36 teeth. Their common module is 5 mm. Determine the centre to centre distance between the gear axis.

4. Where the epicyclic gear trains are used?

5. Define co-efficient of friction.

6. Infer the advantages of wire ropes over fabric ropes.

7. Give examples of applied forces.

8. State the D'Alembert's Principle.

9. Point out the necessity of balancing.

10. List the applications of damper.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Explain the three inversions of double slider-crank chain with suitable example. (7)

(ii) The lengths of crank and connecting rod of a horizontal reciprocating engine are 125 mm and 500 mm respectively. The crank is rotating at 600 rpm. When the crank has turned 45° from inner dead centre, find analytically, (1) the velocity and acceleration of the slider and (2) the angular velocity and angular acceleration of the connecting rod. (6)

Or

(b) Derive expressions for displacement, velocity and acceleration for a tangent cam operating radial-translating roller follower;

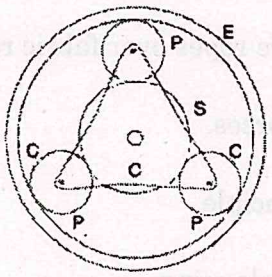
(i) When the contact is on straight flank, and

(ii) When the contact is on circular nose. (13)

12. (a) Two 20° involute spur gears have a module of 10 mm. the addendum is one module. The larger gear has 50 teeth and the pinion 13 teeth. Does the interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference? (13)

Or

(b) An epicyclic gear train consists of a sun wheel S, a stationary internal gear E and three identical planet wheels P carried on a star – shaped planet carrier C. The size of different toothed wheels are such that the planet carrier C rotates at 1/5th of the speed of the sun wheel S. The minimum numbers of teeth on any wheel is 16. The driving torque on the wheel is 100 N-m. Determine number of teeth on different wheels of the train and torque necessary to keep the internal gear stationary. (13)



13. (a) (i) An effort of 1500 N is required to just move a certain body up an inclined plane of angle 12°, force acting parallel to the plane. If the angle of inclination is increased to 15°, then the effort required is 1720 N. Find the weight of the body and the coefficient of friction.(7)

(ii) Pitch of 50 mm diameter threaded screw of a screw jack is 12.5 mm. Coefficient of friction between screw and nut is 0.10. Determine the torque to raise a load of 25 kN rotating with the screw. Also find the torque required to lower the load and efficiency of screw jack. (6)

Or

(b) An open belt drive connects two pulleys 1.2 m and 0.5 m diameter, on parallel shafts 4 meters apart. The mass of the belt is 0.9 kg per meter length and the maximum tension is not to exceed 2000 N. The coefficient of friction is 0.3. The 1.2 m pulley, which is the driver, runs at 200 r.p.m. Due to belt slip on one of the pulleys, the velocity of the driven shaft is only 450 r.p.m. Calculate the torque on ach of the two shafts, the power transmitted, and power lost in friction. What is the efficiency of the drive? (13)

14. (a) Enumerate the steps involved in determining the various forces on the links and torque applied, when a four-bar mechanism is subjected to an external force F on any one of its links. (13)

Or

(b) The length of crank and connecting rod of a horizontal engineer are 200 mm and 1 m respectively. The crank is rotating at 400 rpm. When the crank has turned through 30° from the inner dead centre, the difference of pressure between cover and piston rod is 0.4 N/mm^2. If the mass of the reciprocating parts is 100 kg and cylinder bore is 0.4 meters, then calculate;

(i) Inertia force
(ii) Force on piston
(iii) Piston effort
(iv) Thrust on the sides of the cylinder walls
(v) Thrust in the connecting rod
(vi) Crank effort. (13)

15. (a) A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm, the angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. if the balancing masses revolved at a radius of 100 mm, find their magnitudes and angular positions. (13)

Or

(b) A body having a mass of 15 kg is suspended from a spring which deflects 12 mm under the weight of the mass. Determine the frequency of the free vibrations. What is the viscous damping force needed to make the motion aperiodic at a speed of 1 mm/s?

If, when damped to this extent, a disturbing force having a maximum value of 100 N and vibrating at 6 Hz is made to act on the body, determine the amplitude of the ultimate motion. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A cam is to be designed for knife edge follower with the following data,

(i) Cam lift = 40 mm during 90° of cam rotation with the simple harmonic motion.

(ii) Dwell for the next 30°.

(iii) During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion.

(iv) dwell during the remaining 180°.

Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft. The radius of the base circle of the cam is 40 mm. determine the maximum velocity and acceleration of the follower during its ascent and decent, if the came rotates at 240 rpm. (15)

Or

(b) A rotor is driven by a co-axial through a single plate clutch, both sides of the plate being effective. The external and internal diameters of the plate are respectively 220 mm and 160 mm and the total spring load spring load pressing the plates together is 570 N. The motor armature and shaft has a mass of 800 kg with an effective radius of gyration of 200 mm. The rotor has a mass of 1300 kg with an effective radius of gyration of 180 mm. The coefficient of friction for the clutch is 0.35.

The driving motor is brought up to speed of 1250 r.p.m. when the current is switched off and the clutch suddenly engaged. Determine;

(i) The final speed of motor and rotor

(ii) The time to reach this speed and

(iii) The kinetic energy lost during the period of slipping. (15)

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Question Paper Code : 30255

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023

Third/Fourth Semester

Manufacturing Engineering

ME 3392 – ENGINEERING MATERIALS AND METALLURGY

(Common to : Mechanical Engineering/Mechanical Engineering (Sandwich)/ Mechanical and Automation Engineering)

(Regulations – 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Differentiate between substitutional and interstitial solid solution.

2. What is an equilibrium phase diagram?

3. List the different types of annealing.

4. What is the significance of TTT diagram in the heat treatment of steel?

5. List four important alloying elements added in alloy steels.

6. Why does the aluminium replace the copper as an electrical conductor?

7. What are the characteristics of plastics which account for their wide use as engineering materials?

8. Name any four thermoplastics and thermosetting plastics.

9. Differentiate between ductility and malleability.

10. List the main parameters which may be determined in a tensile test.

PART B — (5 × 13 = 65 marks)

11. (a) Draw iron-iron carbide phase diagram, name the various field, line and reactions.

Or

(b) Explain the following invariant reactions with reference to a phase diagram.

(i) Eutectic reaction (7)

(ii) Eutectoid reaction (6)

12. (a) Write a short notes on the following:

(i) Full annealing (4)

(ii) Recrystallation annealing (5)

(iii) Normalizing (4)

Or

(b) Write short notes on the following surface heat treatment operations:

(i) Carburising and its types (9)

(ii) Nitriding (4)

13. (a) Write an engineering brief about the following steels

(i) Tool Steels (7)

(ii) HSLA steels (6)

Or

(b) Discuss the properties of any four copper alloys.

14. (a) (i) Differentiate between thermosetting and thermos plastics. (7)

(ii) Write a short note on PVC. (6)

Or

(b) What are the properties and application of Al_2O_3, SiC and Si_3N_4.

15. (a) Define fracture. List and explain the different types of fracture.

Or

(b) What is meant by Plastic deformation? Discuss the role of slip and twinning in plastic deformation of materials. Also differentiate between slip and twinning.

PART C — (1 × 15 = 15 marks)

16. (a) Discuss the various types of titanium alloy, their composition, properties and applications.

Or

(b) Discuss the classifications of cast iron and draw its microstructure.

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Question Paper Code : 30240

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third Semester

Aeronautical Engineering

MA 3351 — TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to Aerospace Engineering/Automobile Engineering/Biomedical Engineering/Civil Engineering/Manufacturing Engineering/Marine Engineering/Materials Science and Engineering/Mechanical Engineering/ Mechanical Engineering (Sandwich)/ Mechanical and Automation Engineering/Mechatronics Engineering/Medical Electronics/Petrochemical Engineering/Production Engineering/Robotics and Automation/Safety and Fire Engineering/Bio Technology/Biotechnology and Biochemical Engineering/Food Technology/Petrochemical Technology/Petroleum Engineering/Pharmaceutical Technology)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Form the PDE by eliminating the arbitrary constants 'a and b' from the relation $z = (x + a)\,(y + b)$.

2. Find the PDE corresponding to the complementary function $z = f_1(y + x) + x\,f_2(y + x) + f_3(y - x) + x\,f_4(y - x)$.

3. If $f(x)$ is defined in $(-\pi, \pi)$ and if $f(x) = x + 1$ in $(0, \pi)$, then find $f(x)$ in $(-\pi, 0)$ if

   (a) $f(x)$ is odd

   (b) $f(x)$ is even.

4. Determine the value of b_{25} while expanding the function $f(x) = \begin{cases} 1 + \dfrac{2x}{l}; & -l \le x \le 0 \\ 1 - \dfrac{2x}{l}; & 0 \le x \le l \end{cases}$ as a Fourier series.

5. A tightly stretched string of length '$2L$' is fastened at both ends. The midpoint of the string is displaced to a distance 'b' and released from rest in this position. Write the boundary conditions.

6. The ends A and B of a rod 100 cm long, have their temperatures kept at 10°C and 100°C respectively. Then find the steady state temperature distribution function.

7. Obtain the Fourier transform of $f(x) = \begin{cases} 1; & for\ |x| \le 1 \\ 0; & for\ |x| > 1. \end{cases}$

8. State Convolution theorem for Fourier transforms.

9. Find the inverse Z transform of the unit impulse sequence $\delta(n) = \begin{cases} 1; & for\ n = 0 \\ 0; & for\ n \neq 0. \end{cases}$

10. State Initial value theorem in Z transforms.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Solve : $(x - 2z)p + (2z - y)q = y - x$ (8)

(ii) Solve : $(D^2 + DD' - 6D'^2)z = \cos(2x + y)$. (8)

Or

(b) (i) Solve : $\frac{\partial^2 z}{\partial x^2} + z = 0$, given that when $x = 0$, $z = e^y$ and $\frac{\partial z}{\partial x} = 1$. (8)

(ii) Obtain the general solution of $(D^2 - 2DD' + D'^2)z = \sin x$. (8)

12. (a) Obtain the Fourier series expansion of $f(x) = 2x - x^2$ in the interval $0 < x < 3$. (16)

Or

(b) The displacement y of a part of a mechanism is tabulated with corresponding angular movement $x°$ of the crank. Express y as a Fourier series neglecting the harmonics above the third. (16)

$x°$:	0	30	60	90	120	150	180	210	240	270	300	330
y :	1.80	1.10	0.30	0.16	1.50	1.30	2.16	1.25	1.30	1.52	1.76	2.00

13. (a) A tightly stretched string of length l is fastened at both ends. Initially in equilibrium position. It is set vibrating by giving each point a velocity $v_0 \sin^3\left(\frac{\pi x}{l}\right)$. Find the displacement y at any distance x from one end at any time t. (16)

Or

(b) A bar with 100 cm long, with insulated sides, has its ends kept at 0°C and 100°C respectively until steady state conditions prevail. The two ends are then suddenly insulated and kept so. Then, find the temperature distribution function. (16)

14. (a) (i) Find the Fourier transform of $f(x)$ given by $f(x) = \begin{cases} 1-x^2, & for\ |x| \le 1 \\ 0, & for\ |x| > 1. \end{cases}$ Hence evaluate

$$\int_0^\infty \frac{x\cos x - \sin x}{x^3} \cos\left(\frac{x}{2}\right) dx .$$ (10)

(ii) If $F(s)$ is the complex Fourier transform of $f(x)$, then prove that $F\{f(x-a)\} = e^{isa} F(s)$. (6)

Or

(b) Find the Fourier transform of $f(x) = e^{-a^2x^2}$, $a > 0$. Hence deduce that $e^{\frac{-x^2}{2}}$ is self reciprocal in respect of Fourier transform. (16)

15. (a) Using Z transform, solve the difference equation $u_{n+2} - 2u_{n+1} + u_n = 3n + 5$. (16)

Or

(b) State and prove the convolution theorem in Z transforms and apply it to find $Z^{-1}\left\{\frac{z^2}{(z-2)(z-3)}\right\}$. (16)

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Question Paper Code : 30253

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third Semester

Automobile Engineering

ME 3351 – ENGINEERING MECHANICS

(Common to Civil Engineering/Industrial Engineering/Industrial Engineering and Management/Materials Science and Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering/Robotics and Automation/Safety and Fire Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. The guy wire of a electric pole shown in Figure 1 makes 30° to the pole and is applying a force of 12 kN. Find the horizontal and vertical component of the force. Express it in the vector form taking horizontal direction as x-axis and vertical as y-axis.

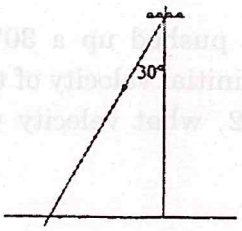

Fig. 1

2. Draw the free body diagram for the given Figure 2.

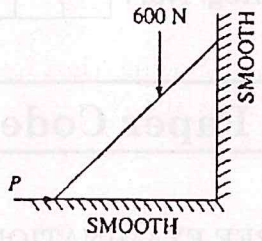

Fig. 2

3. Determine the moment of 400 N force acting at B in $x-y$ plane about point A, as shown in Figure 3.

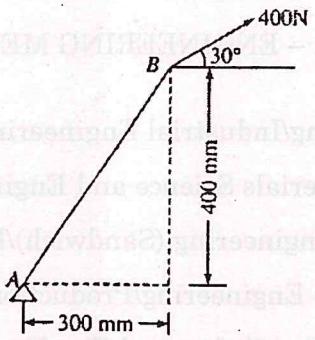

Fig. 3

4. Define Sliding Vector.

5. Derive Centroid of a Semicircle.

6. Derive Moment of inertia of a triangle about the base.

7. List out the laws of Coloumb Friction.

8. Define Angle of Friction.

9. The motion of a particle moving in a straight line is given by the Expression $s = t^3 - 3t^2 + 2t + 5$, where, s is the displacement in metres and t is the time in seconds. Determine velocity and acceleration after 4 seconds.

10. A body weighing 300 N is pushed up a 30° plane by a 400 N force acting parallel to the plane. If the initial velocity of the body is 1.5 m/s and coefficient of kinetic friction is $\mu = 0.2$, what velocity will the body have after moving 6 m?

PART B — (5 × 13 = 65 marks)

11. (a) Three cables are connected at A, where the forces P and Q are applied as shown in Figure 11(a). Knowing that Q = 0, find the value of P for which the tension in cable AD is 305 N. (13)

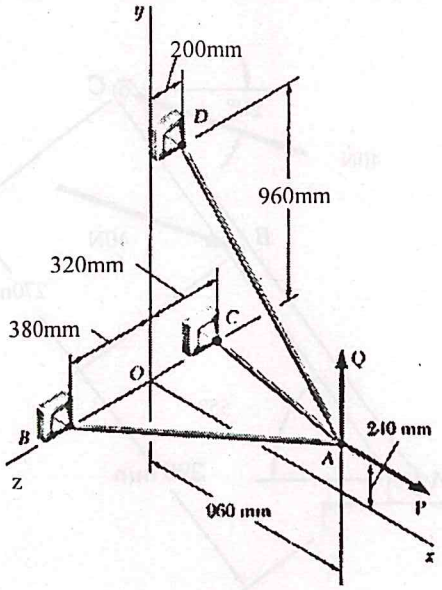

Fig. 11(a)

Or

(b) A rectangular plate is supported by three cables as shown in Figure 11(b). Knowing that the tension in cable AC is 60 N, determine the weight of the plate. (13)

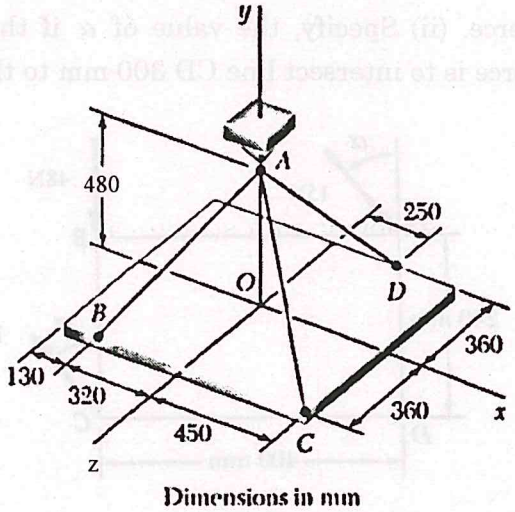

Fig. 11(b)

12. (a) Two parallel 40 N forces are applied to a lever as shown in Figure 12(a). Determine the moment of the couple formed by the two forces (i) by resolving each force into horizontal and vertical components and adding the moments of the two resulting couples, (ii) by using the perpendicular distance between the two forces, (iii) by summing the moments of the two forces about Point A. (13)

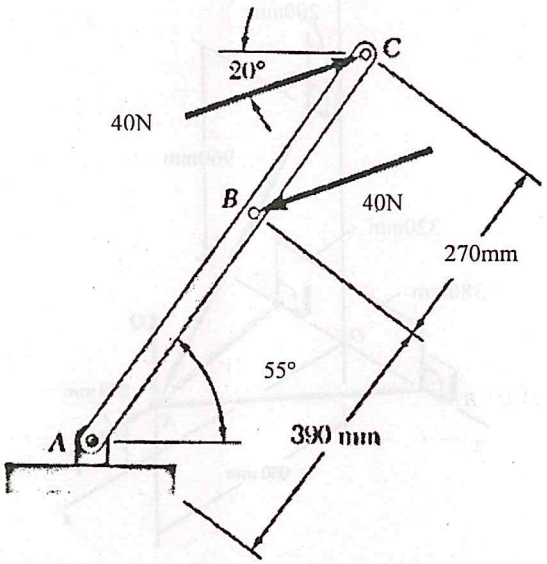

Fig. 12(a)

Or

(b) A rectangular plate is acted upon by the force and couple shown in Figure 12(b). This system is to be replaced with a single equivalent force. (i) For α = 40°, specify the magnitude and the line of action of the equivalent force. (ii) Specify, the value of α if the line of action of the equivalent force is to intersect line CD 300 mm to the right of D. (13)

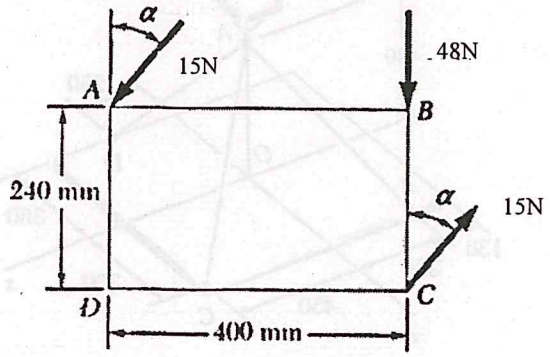

Fig. 12(b)

13. (a) Find moment of inertia of the shaded area shown in Figure 13(a) about axis AB. (13)

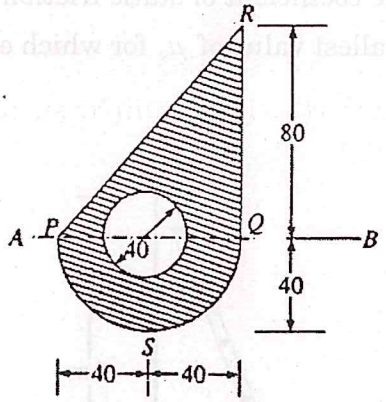

Fig. 13(a)

Or

(b) For the machine element shown in Figure 13(b), locate the x coordinate of the center of gravity. (13)

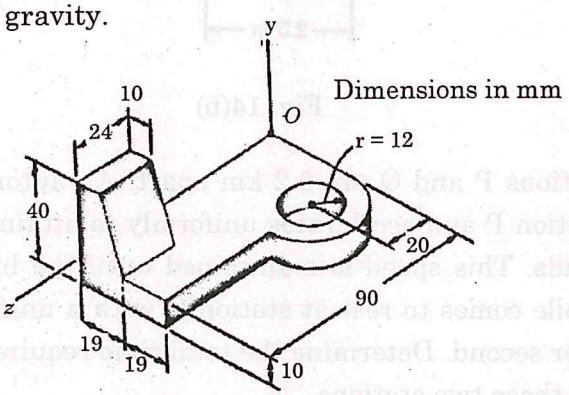

Fig. 13(b)

14. (a) Block A weighing 1000 N rests over block B which weighs 2000 N as shown in Figure 14(a). Block A is tied to wall with a horizontal string. If the coefficient of friction between A and B is 1/4 and between B and the floor is 1/3, what should be the value of P to move the block B if (i) P is horizontal? (ii) P acts 30° upwards to horizontal? (13)

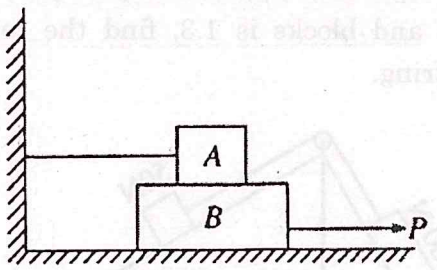

Fig. 14(a)

Or

(b) A 6.5-m ladder AB leans against a wall as shown in Figure 14(b). Assuming that the coefficient of static friction μ_s is the same at A and B, determine the smallest value of μ_s for which equilibrium is maintained. (13)

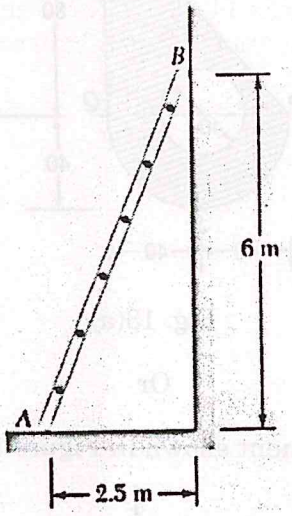

Fig. 14(b)

15. (a) Two stations P and Q are 5.2 km apart. An automobile starts from rest from station P and accelerates uniformly to attain a speed of 48 kmph in 30 seconds. This speed is maintained until the brakes are applied. The automobile comes to rest at station Q with a uniform retardation of one metre per second. Determine the total time required to cover the distance between these two stations. (13)

Or

(b) Two rough planes inclined at 30° and 60° to horizontal are placed Back to back as shown in Figure 15(b). The blocks of weights 50 N and 100 N are placed on the faces and are connected by a string running parallel to planes and passing over a frictionless pulley. If the coefficient of friction between planes and blocks is 1.3, find the resulting acceleration and tension in the string. (13)

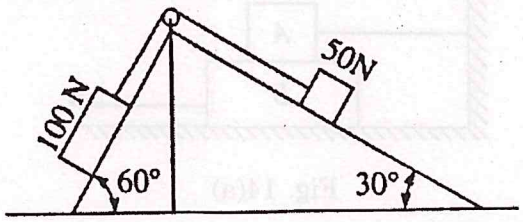

Fig. 15(b)

PART C — (1 × 15 = 15 marks)

16. (a) When they are 18 m apart, two blocks A and B are released from rest on a 30° incline. The coefficient of friction under the upper block A is 0.2 and that under the lower block B is 0.4 [Figure 16(a)]. In what time does block A reach the block B? After they touch and move as a single unit, what will be the contact force between them? Weights of the block A and B are 100 N, and 80 N respectively. (15)

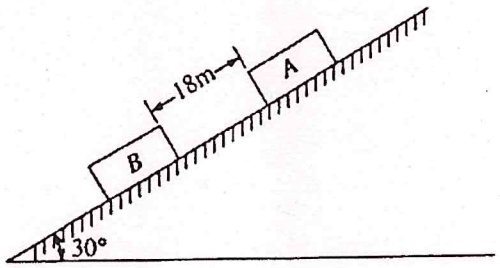

Fig. 16(a)

Or

(b) A 500-N concrete block is to be lifted by the pair of tongs shown in Figure 16(b). Determine the smallest allowable value of the coefficient of static friction between the block and the tongs at F and G. (15)

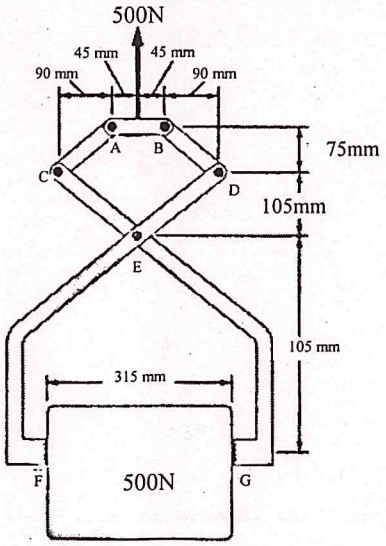

Fig. 16(b)

MBCA