JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH./ME/MC-ME501/2023-24
2023
Essence of Indian Knowledge Tradition

Full Marks: 70 Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions 5x2=10

1. Define 'Traditional Technical Knowledge'. 2
2. Describe different aspects of Traditional Knowledge. 2
3. Categorize TK based on its nature and types. 2
4. Differentiate between western knowledge and indigenous knowledge. 2
5. Write down few TK system-based practices. 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***five/ four*** questions 12x5 /4x15=60

6. (i) Write a short note on "Convention on Biodiversity (CBD)". 5
   (ii) Write a short note on "Bio prospecting Contracts". 5
   (iii) Write a short note on "Patent Law". 5
7. (i) Write a short note on various factors affecting the transmission, preservation, and protection of TK. 5
   (ii) Brieflydiscuss aboutthe abuses of Traditional Knowledge. 5
   (iii) Explain OCAP in detail. 5
8. (i) Why was TKDL set up? 5
   (ii) What are the goals of TKDL? 5
   (iii) Name various international organizations that can access TKDL? 5
9. (i) What is biopiracy? Discuss in brief. 5
   (ii) How does biopiracy happen? 5
   (iii) Is biopiracy illegal? explain. 5
10. (i) Why there is a need to stop biopiracy? 5
    (ii) Elaborate the various actions taken against biopiracy? 5
    (iii) Why companies choose Biopiracyinstead of Bioprospecting? 5
11. (i) Why should we protect Traditional Knowledge? 5
    (ii) Why do you think environmental, social, and economic sustainability are related to Traditional Knowledge system? 5
    (iii) How is Traditional Knowledge protected in India? 5
12. (i) Write down the key features of "Biological Diversity Act, 2002". 5
    (ii) Write down the key features of "Geographical Indication Act, 2003". 5
    (iii) Write down the key features of "Protection of Plant Varieties and Farmers' Rights Act, 2001" 5

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JGEC/B.TECH/ME/PC-ME503/2023-24
2023
Kinematics and Theory of Machines

Full Marks: 70 Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are instructed to write the answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions **5x2=10**

1. Differentiate between mechanism and structure.
2. Define kinematic inversion with an example.
3. Define the terms ***'base circle'*** and ***'pressure angle'*** in a cam.
4. What are spring-controlled governors? State the advantages of spring-controlled governors over gravity-controlled governors?
5. Define the terms 'coefficient of fluctuation of energy'and 'coefficient of fluctuation of speed', in the case of flywheels.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***four*** questions **4x15=60**

6. (i) Explain different kinds of kinematic pairs giving example for each one of them. 5

   (ii) What do you understand by degrees of freedom? For a plane mechanism, derive an expression for Grubler's equation. 5

   (iii) Explain with a suitable sketch of RATCHET and ESCAPEMENT MECHANISM. 5

7. (i) Deduce the expression for minimum number of teeth on pinion to avoid interference. 5

   (ii) In an epicyclic gear of the 'SUN' and 'PLANET' type shown in Fig. 1, the pitch circle diameter of the internally toothed gear is 224 mm and the module is 4mm. When the internal gear 'A' is stationary, the spider 'a', which carries three planet gears 'P' of equal size, is to make one revolution in the same sense as the sun gear 'S' for every five revolutions of the driving spindle carrying the sun gear 'S'. Determine suitable number of teeth for all the gears. 10

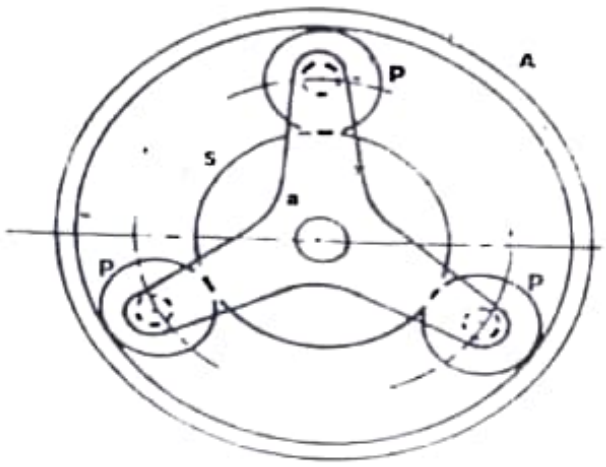

Fig. 1

8. (i) Draw and deduce the expressions of velocity and acceleration of the follower when it moves with SHM. Find out the maximum velocity, maximum acceleration and show it in the diagrams.

(ii) A machine supported symmetrically on four springs has a total mass of 100 kg. The mass of the reciprocating parts is 2.2 kg which moves through a vertical stroke of 90 mm with simple harmonic motion. The machine is having only one degree of freedom and can undergo vertical displacement only. 7

Determine the combined stiffness of the springs if the force transmitted to the foundation is 1/20th of the impressed force. Neglect damping and take the speed of rotation of the machine crank shaft as 900 rpm.

If, under actual working conditions, the damping reduces the amplitudes of successive vibrations by 25%, find the force transmitted to the foundation at 900 rpm.

(iii) A rigid body, under the action of external forces, can be replaced by two masses placed at a fixed distance apart. State the conditions of placing the two masses so that the two masses form an equivalent dynamical system. 2

9. (i) Derive and briefly explain (with diagram) Coriolis component of acceleration. 6

(ii) Locate all the Instantaneous centres of the slider crank mechanism as shown in Fig. 2 . 9
The lengths of various links are : OA = 160 mm ; AB = 470 mm ; OB=600 mm.
If the link OA rotates at an angular speed of 12 rad/sec in the clockwise direction, find (a) the velocity of the slider B and (ii) angular velocity of the connecting rod AB
(Use Graphical Method or I-Centre Method)

(N.T.S.)

Fig. 2

10. *i) A shaft with 4 metres span* between two bearings carries two masses of 10 kg and 20 kg acting at the extremities of arms of 0.4 metre and 0.5 metre long respectively. The planes in which these masses rotate are 1.4 and 3.0 metres respectively from the left end bearing supporting the shaft. The angle between these arms is 40°. The speed of rotation of the shaft is 300 r.p.m. If the masses are balanced by two counter masses rotating with the shaft acting at radii of 0.4 metre and placed at 0.5 metre from each bearing centres, estimate the magnitude of the two balance masses and their orientation with respect to the mass of 10 kg. 10

ii) In a single degree damped vibrating system, a suspended mass of 7.5 kg makes 27 free oscillations in 16 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.16 times of its initial value after 5 oscillations. Determine: 5

a) the stiffness of the spring
b) the logarithmic decrement and
c) the damping coefficient.

11. i) The mass of each ball of a Hartnell type governor is 1.5 kg. The length of ball arm of the bell-crank lever is 90 mm whereas the length of arm towards sleeve is 50 mm. The distance of the fulcrum of the bell-crank lever from the axis of rotation is 70 mm. The extreme radii of rotation of the balls are 60 mm and 100 mm. The minimum and maximum equilibrium speeds are 350 r.p.m. and 370 r.p.m. respectively. Neglecting obliquity of the arms determine: 7

a) stiffness of the spring
b) total lift of the sleeve and
c) equilibrium speed when radius of rotation of the balls is 90 mm.

A punching machine is required to punch 30 mm diameter holes in a plate of 16 mm thickness at the rate of 20 holes per minute. It requires 8 N-m of energy per mm^2 of sheared area. The actual punching takes place in one-fifth the interval between two successive punching operations. A flywheel is fitted to the machine shaft which is driven by a constant torque motor. The speed of the machine fluctuates between 160 to 140 r.p.m. Determine: 8

a) the power of the motor required to drive the punching machine
b) the maximum fluctuation of energy and
c) the mass of the flywheel required to keep the speed fluctuation in the given range if the mean speed of the flywheel is 25 meters per second.

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JGEC/B.TECH/ME/ PC-ME502/2023-24
2023
SOLID MECHANICS

Full Marks: 70 Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer *all* questions 5x2=10

1. What do you understand by direction cosine?
2. Define principal plane.
3. Define state of stress at a point.
4. What is meant by octahedral stress?
5. Draw the stress distribution in a thick cylinder subjected to internal pressure.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any *four* questions 15x4=60

6 a) What do you understand by Compatibility of strain? 3

b) The stress tensor at a point is as follows

$$\begin{bmatrix} 40 & -25 & 50 \\ -25 & -80 & 60 \\ 50 & 60 & 70 \end{bmatrix} \text{ Mpa}$$

Determine normal and shear stresses on a plane whose unit normal has direction cosine of $\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{\sqrt{2}}\right)$ 12

7 a) The state of stress at a point is characterised by the components (units are 1000 kPa) 15

$\sigma_x = 90, \sigma_y = -50, \sigma_z = 30, \tau_{xy} = -20, \tau_{yz} = 60, \tau_{zx} = 40.$

Determine the Principal stresses. Also find the direction of maximum Principal stress.

8. a) The displacement field for a body is given by;

$u = (9x + 7y^3 + 10z)i + (2x^2 + 5y + 3z^2)j + (4x^3 + 3y - 7z)k$ 6

What is the deformed position of a point originally at *(2, 5, 3)?* Also find the distance of the final position from origin.

b) Given the following system of strains 9

$\varepsilon_{xx} = 9 + x^3 + y^3 + 6x^5 + 6y^5$

$\varepsilon_{yy} = 7 + 5x^3 + 5y^3 + x^5 + y^5$

$\gamma_{xy} = 15 + 8xy\,(x^3 + y^3 + 5)$

$\varepsilon_{zz} = \gamma_{yz} = \gamma_{zx} = 0$

Check compatibility condition and determine whether the above strain field is possible.

9. a) Write down the generalized Hook's Law. 3

b) For steel, the following data is applicable: 12

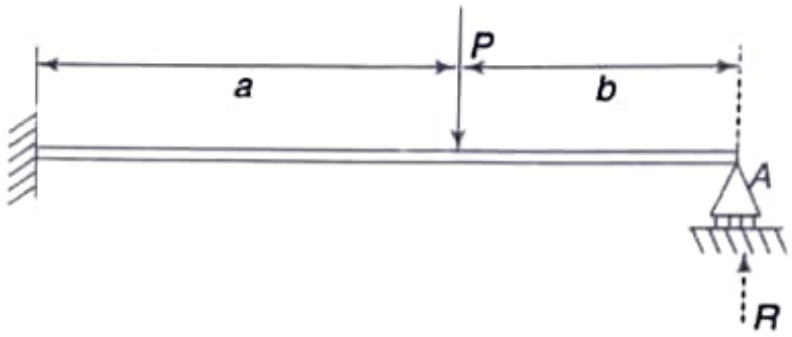
E= 210 Gpa and G=80 Gpa

For the given strain matrix at a point, determine the stress matrix.

$$\begin{bmatrix} 0.002 & 0 & -0.003 \\ 0 & -0.005 & 0.004 \\ -0.003 & 0.004 & 0 \end{bmatrix}$$

10. a) Derive equations of equilibrium in cartesian coordinates. 7

b) Determine the support reaction for the propped cantilever using Energy Method. 8



11. A thick-walled steel cylinder with radii a = 10 cm and b = 20 cm is subjected to an internal pressure P. The yield stress in tension for the material is 450 MPa. Using a factor of safety of 2, determine the maximum working pressure P according to Maximum principal stress, Maximum shear stress, Maximum Strain Theory and Octahedral Shear Stress theories of failure. E = 210 GPa, v = 0.3. 15

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JGEC/B.TECH/ME/PC-ME501/2023-24 / Dec'23 Exam/
2023
HEAT TRANSFER (For REGULAR Students)

Full Marks: 70 Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer ***all*** questions. 5x2=10

1. Does the Effectiveness of a fin increase or, decrease as the fin length is increased? Explain.
2. Can a rectangular slab have a critical thickness of insulation? Explain.
3. Consider a real fruit apple and an apple made of gold. Size and shape of both the apples are same. Both are placed at the same ambient condition. For which case lumped system heat transfer analysis is likely to be more applicable and why?
4. What is 'Black Body'?
5. Write the physical significance of 'Nusselt Number'.

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any ***four*** questions 4x15=60

6. i) Derive three-dimensional general heat conduction equation in Cartesian co-ordinate. Derive Laplace equation from the above derived three-dimensional equation. (7)

   ii) Consider one dimensional steady state heat conduction without any internal heat generation through a thin metal bar of 10 cm long. Write the relevant heat conduction equation and determine temperature at a distance of 6 cm from one end of the bar where the temperature is 100^0C. The temperature at the other end of the bar is 200^0C. (3)

   iii) A thermocouple junction, which may be considered as a sphere, is to be used for temperature measurement in a gas stream. The convection heat transfer co-efficient between the junction surface and the gas is h = 400W/m^2.K, and the junction thermophysical properties are : k (thermal conductivity) = 20 W/m.K, C(specific heat) = 400 J/kg.K, and density = 8500 kg/m^3. Relevant Biot number may be considered as much less than 0.10.
   Determine the junction diameter needed for the thermocouple to have a time constant of 1 second. If the junction, initially at 25^0C, is placed in a gas stream that is at 200^0C, how long will it take for the junction to reach 199^0C? (5)

7. i) Derive expressions of temperature profile and heat flux for an insulated tip rectangular thin fin having uniform cross-section under steady state condition. Consider one dimensional heat conduction. (7)

   ii) Thin fins of rectangular profiles are attached to a plane hot wall. There are equally spaced 100 number of fins per metre height of the wall. Each fin thickness is 1 mm, length (which is perpendicular to plane wall) is 8 mm and width (which is parallel and equal to plane wall width) is 1m. Thermal conductivity of fin material is 80 W/m.K. The plane wall is maintained at a temperature of 230^0C and the fins dissipate heat to ambient (ambient temperature 30^0C) with convective heat transfer coefficient of 36 W/m^2.K.
   Calculate :
   a) Fin efficiency
   b) Heat loss from the fins only for per metre height of the plane wall
   c) Total heat dissipation from the plane wall area of 1m (height) x 1m (width) considering both finned and unfinned areas
   d) Area weighted fin efficiency (8)

8. i) Derive expression of Critical Radius of insulation for a cylindrical object in terms of thermal conductivity of the insulating material and associated heat transfer coefficient with ambient. (5)

ii) Derive expression of LMTD (Log Mean Temperature Difference) for heat transfer process in a simple parallel flow heat exchanger. (6)

iii) A hot gas (C_P = Specific heat = 1.12 kJ/kg-K) flowing through a tubular heat exchanger at a rate of 1200 kg/hr is cooled from 400^0C to 120^0C. The cooling is affected by water (C_P =Specific heat =4.18 kJ/kg-K) that enters the heat exchanger at 10^0C at a rate of 1500 kg/hr. The Overall heat transfer co-efficient is 500 kJ/ (m^2.hr.K). Determine the area required for the heat exchanger. Consider parallel flow arrangement. (4)

9. i) Explain the term 'momentum thickness' in case of formation of boundary layer. Determine its expression in terms of local velocity and free stream velocity, u/U. (4)

ii) What is thermal boundary layer? (3)

iii) Air at 20^0C and 1 bar flows over a flat plate at 25 m/s which is maintained at 60^0C, bottom side is insulated. The plate is 100 cm X 75 cm in dimension. The flow is along 75 cm side. Take the following properties of air at mean temperature of 40^0C. Density = 1.13 kg/m^3, thermal conductivity = 0.02723 W/m-K, specific heat at constant pressure = 1.007 KJ/kg-K, Prandtle No. = 0.7, dynamic viscosity = 20 X 10^{-6} kg/m-s. Use the following equation for average Nusselt Number: $Nu = (0.037\ Re^{0.8} - 850)\ Pr^{1/3}$. Find the rate of convective heat transfer from the plate to the air. (8)

10. i) A hot square plate of 50 cm X 50 cm surface dimensions at 100^0C is exposed to atmospheric air at 20^0C. Find the heat loss from both surfaces of the plate if the plate is kept vertical. The properties of air at average temperature 60^0C are given as follows: density = 1.06 kg/m^3, thermal conductivity = 0.028 W/m-K, specific heat at constant pressure = 1.007 kJ/kg-K, kinematic viscosity = 18.7 X 10^{-6} m^2/s. The following relation can be used. $Nu = 0.13\ (Gr.Pr)^{1/3}$. Consider air as an ideal gas. (8)

ii) Water at 20^0C with a flow rate of 0.015 kg/s enters a 2.5 cm ID tube which is maintained at a uniform temperature of 90^0C. Assuming hydro-dynamically and thermally fully developed flow, determine the heat transfer coefficient and the tube length required to heat the water to 70^0C. [water properties at 45^0C : specific heat = 4180 J/kg-K, thermal conductivity = 0.638 W/m-K, kinematic viscosity = 0.613 X 10^{-6} m^2/s] Average Nusselt number for the tube flow Nu = 3.657. (7)

11. i) What is view factor ? –Explain. Discuss four fundamental rules or relations of view factors. (4)

ii) Write and prove the statement of Kirchhoff's law of radiation. (4)

iii) The temperature of the filament of an incandescent light bulb is 2000K. Assuming the filament to be a black body, determine a) total emissive power of the bulb and b) its emissive power in the wave length range from 1 micro meter to 2 micrometer. Black body radiation function chart is given below. . Take Stefan- Boltzmann constant = 5.67 X 10^{-8} W/m^2- K^4 (7)

λT (μm-K)	2000	3000	4000
f_λ	0.0667	0.273	0.481