**R-14**

**Code: 4PE521**

*M. Tech. II-Semester Regular Examinations Oct/Nov 2015*

# Advanced Optimization Techniques

( Common to CAD/CAM & Machine Design)

Max. Marks: 60 Time: 3 Hours

Answer *all five* units by choosing one question from each unit ( 5 x 12 = 60Marks )

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## UNIT-I

1. Maximize $z = 2x_1 + 3x_2$

   Subject to:

   $x_1^2 + x_2^2 \leq 20$

   $x_1 x_2 \leq 8$

   $x_1, x_2 \geq 0$

   Use Kuhn- tucker conditions 12M

OR

2. a) The total profit (z) of a firm depends upon the level of output (Q) and the advertising expenditure (A). Find the profit maximizing values of Q and A given the following relationship.

   $z = 800 - 3Q^2 - 4Q + 2QA - 5A^2 + 48A$ 6M

   b) Explain Lagrangian method for solving non –linear programming problem 6M

## UNIT-II

3. Solve using two phase Simplex method:

   Maximize $z = 5x_1 + 8x_2$

   Subject to the constraints:

   $3x_1 + 2x_2 \geq 3$

   $x_1 + 4x_2 \geq 4$

   $x_1 + x_2 \leq 5$

   $x_1 \geq 0;\ x_2 \geq 0$ 12M

OR

4. A company has 5 jobs to be done. The following matrix shows the returns in rupees on assigning $i_{th}$ machine to the $j_{th}$ job. Assign the five jobs to the five machines so as to maximize the total profit

| Machine/Jobs | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | 5 | 11 | 10 | 12 | 4 |
| 2 | 2 | 4 | 9 | 3 | 5 |
| 3 | 3 | 12 | 5 | 14 | 6 |
| 4 | 6 | 14 | 4 | 11 | 7 |
| 5 | 7 | 9 | 8 | 12 | 5 |

12M

UNIT-III

5. $Minimize\ f(x_1,x_2) = x_1^2 - x_1x_2 + 3x_2^2$ *using* Steepest descent method. *Take starting point* $(1,2)$ .Take tolerance $\epsilon = 0.1$ 12M

OR

6. Solve the following problem by using interior penalty function approach. $Minimize\ f(x_1,x_2) = (x_1)^2 - 2x_1 - 1$ Subject to: $1 - x_1 \geq 0$ 12M

UNIT-IV

7. a) List out the Applications of genetic algorithm 6M
   b) What are the Advantages and limitations of genetic algorithm 6M

OR

8. a) Find a tour of a given set of cities so that Each city is visited once and only once The total distance traveled is minimum

| To→ From↓ | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | - | 3 | 6 | 2 | 3 |
| 2 | 3 | - | 5 | 2 | 3 |
| 3 | 6 | 5 | - | 6 | 4 |
| 4 | 3 | 2 | 6 | - | 6 |
| 5 | 3 | 3 | 4 | 6 | - |

12M

UNIT-V

9. Explain the steps to optimize cutting parameters in turning 12M

OR

10. Design the steps to optimize spring design 12M

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Code: 4PF521

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# Mechanical Vibrations

(Machine Design)

Max. Marks: 60 Time: 3 Hours

Answer *all five* units by choosing one question from each unit ( 5 x 12 = 60Marks )

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## UNIT-I

1. a) Explain vibrations due to unbalance masses 5M

   b) A vibrating system of mass 8 kg, spring stiffness 5.2 KN/m and a dashpot of Damping coefficient of 200 N/M/s determine i) Damping factor ii) logarithmic decrement iii) ratio of two consecutive amplitudes iv) frequency of damped vibration 7M

**OR**

2. a) A vertical single cylinder diesel engine of 700 kg mass is mounted on springs with K=260 KN/m and dampers with damping factor 0.2. The rotating parts are well balanced. The mass of the equivalent reciprocating parts is 11 kg and the stroke is 220mm. Determine the force transmitted to the foundation if the engine runs at 260 rpm. 7M

   b) Explain Vibration transmissibility and derive transmissibility equation 5M

## UNIT-II

3. a) Explain seismic instruments in detail 5M

   b) A vibrating body is supported by six isolators each having stiffness 32000 N/M and six dashpots each having damping factor as 420 N-Sec/M. The vibrating body is to be isolated by a rotating device having an amplitude of 0.06 mm at 550 RPM. Take m=32 Kg. Determine

   i) Amplitude of vibration body

   ii) Dynamic load on each isolator due to vibration. 7M

**OR**

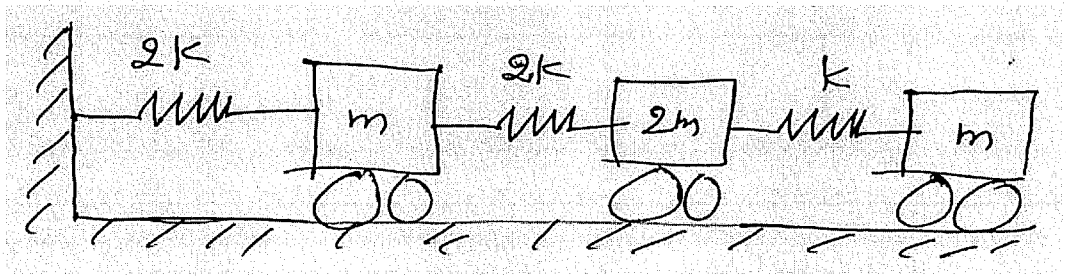
4. Explain dynamic vibration absorber and its characteristics in detail 12M

## UNIT-III

5. Define influence co-efficient and explain how to find influence coefficients of a multi degree system with example 12M

**OR**

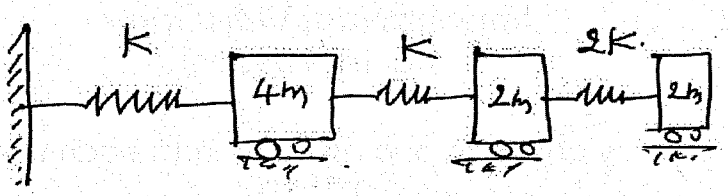
6 Using matrix method determine natural frequencies of the following system




12M

## UNIT-IV

7. Determine the natural frequency and its mode shape of the following system using stadola method




12M

**OR**

8. a) Explain torsional vibrations of geared system 6M

   b) Explain matrix iteration method to find natural frequency of a multi degree freedom system 6M

## UNIT-V

9. a) What is meant by critical speed of shaft 3M

   b) A rotor of mass 5 Kg is mounted on 20 mm diameter shaft at a point 100mm from one end. The 250 mm long shaft is supported by bearings. The equivalent viscous damping of the disc is 50 N-Sec/m. Calculate the critical speed, if the center of gravity of the disk is 0.03mm away from the geometric center of rotor. Find the deflection of the shaft when its speed of rotation is 4000 rpm. Take $E = 1.9 \times 10^{11}$ N/m$^2$. 9M

**OR**

10. Explain the following

    i) Torsional vibrations of shafts

    ii) Transverse vibrations of beams 12M

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# Robotics

(Common to CAD/CAM & Machine Design)

Max. Marks: 60 Time: 3 Hours

Answer *all five* units by choosing one question from each unit ( 5 x 12 = 60Marks )

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## UNIT-I

1. a) Sketch and explain the four basic robot configurations classified according to the coordinate system. 8M

   b) Discuss on the applications of "tools" as robots and end effectors. 4M

**OR**

2. a) Compare the five basic robot configurations according to the work envelope, typical applications, and power sources. 8M

   b) How does the SCARA arm geometry differ from the vertical articulated arm? 4M

## UNIT-II

3. What is a formed kinematics problem? Explain Denavit-Hartenberg convention for selecting frames of reference in robotic application. 12M

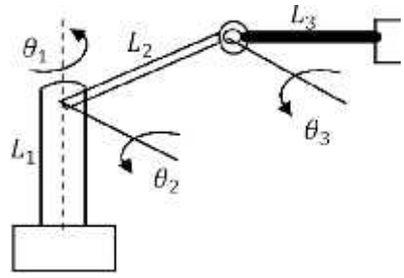
**OR**

4. a) Explain forward and reverse kinematics of robot? 8M

   b) Explain the role of dexterity and degeneracy in robots. 4M

## UNIT-III

5. Determine the manipulator Jacobian matrix for the 3D of articulated arm shown in figure below.




12M

**OR**

6. How Lagrange's equations apply to a simple robotic system. 12M

## UNIT-IV

7. a) Explain the steps involved in trajectory planning. 6M

   b) Explain a 3-5-3 trajectory plan to represent a pick and place movement for an assembly operation. 6M

**OR**

8. a) What are position sensors? What are the different types of position sensors? 8M

   b) What are the conditions that determine the choice of a particular type of position sensor? 4M

## UNIT-V

9. a) Explain robot programming languages? 8M

   b) Explain Textual Robot languages. 4M

**OR**

10. a) Explain modes of robot programming? 8M

    b) Explain Robot language structures. 4M

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# Mechanics of Composite Materials

(Machine Design)

Max. Marks: 60 Time: 3 Hours

Answer *all five* units by choosing one question from each unit ( 5 x 12 = 60Marks )

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## UNIT-I

1. a) Define a composite material. Give the complete classification of composite materials. 7M

   b) Explain potential applications of composites in the fields of marine, electronics aerospace and automobile. 5M

**OR**

2. a) What is the role of matrix and reinforcement in a composite? Explain clearly. 5M

   b) Explain clearly types of matrix materials and reinforcements for different types of composite materials. 7M

## UNIT-II

3. With the help of neat sketches, briefly explain the following processes for manufacturing of composites

   i) Pultrusion 6M

   ii) Resin Transfer Molding (RTM) 6M

**OR**

4. Define stiffness and compliance matrix for an anisotropic materials and explain how it is transformed to orthotropic, monoclinic and isotropic materials. 12M

## UNIT-III

5. The properties of unidirectional Glass/Epoxy lamina are $E_1$ = 38.6 GPa, $E_2$ = 8.27 GPa, $\nu_{12}$ = 0.26 and $G_{12}$ = 4.14 GPa. Find the following for a 60° angle lamina of Glass/Epoxy i) Transformed compliance matrix ii) Transformed reduced stiffness matrix and iii) Global strains. 12M

**OR**

6. Briefly explain the following failure theories which are applicable for fiber reinforced polymer composites.

   i) Maximum stress theory

   ii) Maximum Strain theory

   iii) Tsai-Hill theory

   iv) Tsai-Wu theory 12M

## UNIT-IV

7. a) Obtain an expression for $E_1$, $E_2$, $\nu_{12}$ and $G_{12}$ in terms of material properties with respect to principal material directions using strength of material approach. 7M

   b) For Glass/Epoxy composite $E_f$ = 85 GPa, $E_m$ = 3.4 GPa, Poission's ratio, $\nu_m$ = 0.3 and $\nu_f$ = 0.25, find the minor Poisson's ratio $\nu_{21}$ and $G_{12}$ for a fiber volume fraction of 60%. 5M

**OR**

8. a) Explain in detail semi-empirical models for evaluating elastic constants of a composite lamina. 7M

   b) What are the five ultimate strength parameters of a unidirectional lamina? Explain. 5M

## UNIT-V

9. a) Briefly explain laminate code. Cite some examples to explain the code. 5M

   b) Derive the expressions for flexural engineering constants of a laminate. 7M

**OR**

10. a) What are the various special cases of laminates? Explain in detail cross ply, anti symmetric and balanced laminates. 6M

    b) Briefly explain failure criterion for laminates. 6M

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# Theory of Plasticity

(Machine Design)

Max. Marks: 60 Time: 3 Hours

Answer *all five* units by choosing one question from each unit ( 5 x 12 = 60Marks )

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## UNIT-I

1. Explain Tresca's yield criteria. 12M

**OR**

2. Stress tensor at a point is given by

$\tau_{ij} = \begin{bmatrix} 10 & 15 & 20 \\ 15 & 25 & 15 \\ 20 & 15 & 30 \end{bmatrix}$ Find out principal stresses and their directions. 12M

## UNIT-II

3. Explain the flow rule associated with Von Mises yield function. 12M

**OR**

4. a) Explain the principle of virtual work 6M

   b) Explain stable and unstable stress-strain curves for an elastic solid with sketch. 6M

## UNIT-III

5. Explain Drucker-Prager material model. 12M

**OR**

6. What are the isotropic and kinematic hardening rules? Explain. 12M

## UNIT-IV

7. Explain Secant and Newton-Raphson methods for solving nonlinear equations. 12M

**OR**

8. Explain the steps involved in finite element model of plasticity. 12M

## UNIT-V

9. Explain the boundary surface theory to account for the cyclic behavior of material under multi axial loading. 12M

**OR**

10. What is statically admissible stress field and kinematically admissible velocity field? Explain. 12M

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# Design for Manufacturing

(Machine Design)

Max. Marks: 60 Time: 3 Hours

Answer *all five* units by choosing one question from each unit ( 5 x 12 = 60Marks )

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## UNIT-I

1. a) What are the basic Design philosophy steps in Design process? 6M

   b) Discuss the stages in Engineering design process with the one suitable example. 6M

**OR**

2. What are the basic principles of Designing for economical production? State with a clear example? 12M

## UNIT-II

3. Write a short note on general design rules for machining. Also mention in detail what are the general design recommendations for machined parts. 12M

**OR**

4. What is the role of redesigning? Show the redesigning of components for machine ease with an example? 12M

## UNIT-III

5. List out the general design considerations for casting process. 12M

**OR**

6. a) What is the use of solidification simulation in casting design?—Explain in brief 6M

   b) List out the various types of casting process used? Why special casting techniques are more preferable than sand mould casting? 6M

## UNIT-IV

7. a) How the thermal stresses are occurring at the weld joints? 6M

   b) Write a short notes on pre and post treatment of welds 6M

**OR**

8. a) What are the factors to be considered while designing the dies for drop forging process? 6M

   b) What are the design factors for closed die forging design? 6M

## UNIT-V

9. a) Explain Keeler Goodman forging line diagram with an example? 6M

   b) What are the basic principles for punching and deep drawing operations? 6M

**OR**

10. a) What are the design considerations of injection moulding? 6M

    b) How Visco elastic behavior takes place in Plastics? Explain in brief. 6M

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