Bharatiya Vidya Bhavan's

# SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

**END SEM/RE-EXAM EXAMINATION Dec 2025 / ~~FEB 2026~~**

F.Y. M.Tech mech sem I

**Program: MTech (Machine Design)** **Duration: 3 hrs**

**Course Code: MTMD101** **Maximum Points: 100**

**Course Name: Advanced Stress Analysis** **Semester: I**

1) **Solve any 5 questions out of seven**
2) **Assume suitable data if necessary.**

| Q.No. | Questions | Points | CO | BL |
|---|---|---|---|---|
| 1a | Discuss the empirical equation for fatigue crack growth (Paris Law).<br>An edge crack Detected on a large plate is of length 2.7 mm under a constant amplitude cyclic load of $\sigma_{max}$ = 350 MPa and $\sigma_{min}$ = 200 MPa, Determine propagation life to failure and propagation life if crack length is not allowed to exceed 10mm. | 5<br>5 | 1,3 | 3 |
| 1b | write the equations of equilibrium for 3D stress. Also for given below show that equilibrium exists: $\begin{vmatrix} (3x^2+3y^2-z) & (z-6xy-\frac{3}{4}) & (x+y-\frac{3}{2}) \\ (z-6xy-\frac{3}{4}) & 3y^2 & 0 \\ (x+y-\frac{3}{2}) & 0 & (3x+y-z+\frac{5}{4}) \end{vmatrix}$ | 10 | 1,2 | 3 |
| 2 | Stress component at a point are :<br>3 5 6<br>5 4 2<br>6 2 5<br>Determine the the principal stresses and principal planes. Also determine normal and shearing stresses on a plane whose direction cosines are [ $1/\sqrt{3}$ $1/\sqrt{3}$ $1/\sqrt{3}$] . Also calculate the direction of shear stresses. | 20 | 1,2 | 3 |
| 3a) | Compute the Lame's coefficient $\mu$ and $\lambda$ for<br>Steel having E = 210 GPa and $\upsilon$ = 0.3 :<br>concrete having E = 28 GPa and $\upsilon$ = 0.2 | 10 | 1,2 | 2 |
| 3b) | List and sketch the specimen types used for determine the experimental SIF.<br>Determine critical SIF value if width W = 10.88 mm ; thickness 5.7 mm, S= 44 mm , a/W = 0.47. Load P = 80 N. | 10 | 1,2 | 3 |

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## END SEM/RE-EXAM EXAMINATION Dec 2025 / FEB 2026

| | | | | |
|---|---|---|---|---|
| 4a) | For the given strain matrix below determine the stress matrix. Take E = 200 GPa ,G = 78 GPa.<br>$\begin{matrix} 0.001 & 0 & -0.002 \\ 0 & -0.003 & 0.0003 \\ -0.002 & 0.0003 & 0 \end{matrix}$ | 10 | 1,2 | 3 |
| 4b) | State of a stress at a point is as shown below, determine strain matrix.<br>$\begin{matrix} 9 & 6 & 3 \\ 6 & 5 & 2 \\ 3 & 2 & 4 \end{matrix}$ | 10 | 1,2 | 3 |
| 5 | a) Strain measurement is necessary. Why?<br>b) What are the different experimental methods to measure strain?<br>c) Discuss electrical resistance strain measurement method. | 5<br>5<br><br>10 | 3,4 | 3 |
| 6 | Discuss the following stress measurement methods:<br>a) Moire technique<br>b) Photo elastic method | <br>10<br>10 | 3,4 | 2 |
| 7 | a) Derive the critical crack length formulae using Griffith theory.<br>b) Explain modes of fracture<br>c) Discuss ductile and brittle fracture | 10<br>5<br>5 | 1,3 | 2,3 |
| | $\frac{3\alpha^{1/2}\left[1.99-\alpha(1-\alpha)\left(2.15-3.93\alpha+2.7\alpha^2\right)\right]}{2(1+2\alpha)(1-\alpha)^{3/2}}$ | | | |

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**End Semester Examination – ~~JAN 2026~~ DEC 2025**

F.Y. M.Tech Mech Sem I

**Program:** MTECH (M/C DESIGN) **Duration:** 3hrs

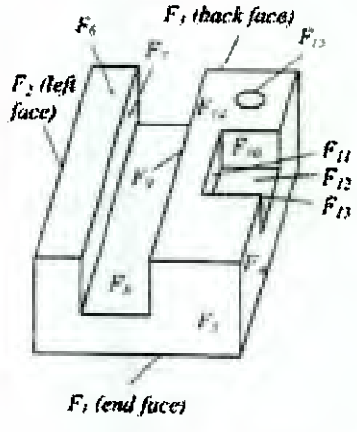
**Course Code:** PC-MTMD102 **Maximum Points:** 100

**Course Name:** CAD **Semester:** I

31/12/25

**Notes:**

- All questions are compulsory
- Figures to the right indicates full marks
- Assume suitable data wherever necessary

| Q.No. | Questions | Points | CO | BL | PI |
|---|---|---|---|---|---|
| Q.1 (a) | A) Triangle LMN has vertices at L(−2,4),M(0,6),N(2,4). It is reflected through the line y=2x+1.Calculate the coordinates of the reflected triangle and represent it graphically<br><br>B] Triangle ABC has vertices at A(1,3),B(5,5),C(3,7). It is desired to reflect through the line y= − x + 4y. Calculate the new vertices of the triangle and show the results graphically. | [10] | 1 | 1 | 3.2. |
| (b) | Explain the role of Artificial Intelligence and Machine Learning (AI/ML) in 3D modeling. Discuss how AI/ML enhances 3D model creation, optimization, simulation, and validation with suitable examples | (10) | 2,4 | 3 | 3.2. |
| Q.2 (a) |  | [10] | 2 | 3 | 3.2. |

| | | | | | |
|---|---|---|---|---|---|
| | **Fig.E**<br>For the object shown above in Fig.E use the graph based feature recognition approach to achieve the following<br>• Develop the AAG of the given object<br>• Give the matrix representation of the AAG<br>• Recognize the features in this object | | | | |
| (b) | Construct a B-spline curve for open uniform vectors with 7 control points and having order 4 (cubic B-spline) with polygon vertices: $S_0(0, 2)$, $S_1(1, 4)$, $S_2(3, 7)$, $S_3(5, 6)$, $S_4(7, 3)$, $S_5(8, 1)$, $S_6(9, 0)$ | [10] | 1 | 1 | 3.2. |
| Q.3 (a) | Develop a Flowchart and C++ program for Design of Muff Coupling, the flowchart & C++ Program should include 1) Design of Shaft 2) Design of Sleeve 3] Design of Key. | [10] | 3 | 3 | 3.2. |
| (b) | Explain the concept of Reverse Engineering. Describe contact and non-contact inspection methods used in reverse engineering with suitable examples | [10] | 2,3,4 | 1 | 3.2. |
| Q.4 (a) | Write a C++ program for line with following 2D transformations using class & object. Use the concept of homogeneous coordinates only.<br>• Translation<br>• Scaling<br>• Rotation<br>• Reflection<br>• Shearing<br>Insert comments wherever necessary. | [20] | 4 | 3 | 5.2. |
| 5 | Write Short Notes on (Any Three)<br>• Object Oriented Databases (OODB)<br>• Geometric modeling techniques<br>• Virtual Manufacturing<br>• Artificial Intelligence in Design<br>• Graphics Standards<br>• Concurrent engineering | [20] | 3,4 | 2 | 5.2.1<br>3.2.1 |
| Q.6 (a) | A triangle is defined by 3 vertices A (0,2,1) B (2,3,0) C (1,2,1). Find the final coordinates after it is rotated by 45 degree around a line joining the points (2,2,2) and (1,1,1) | [10] | 3,4 | 2 | 5.2.1<br>3.2.1 |
| (b) | Explain the concept of Design for Assembly (DFA). Discuss the important guidelines/principles of DFA used in product design and manufacturing along with neat figures | [10] | 3,4 | 2 | 5.2.1<br>3.2.1 |

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**End Semester Examination – ~~JAN 2026~~** DEC 2025

| | | | | | |
|---|---|---|---|---|---|
| Q.7 (a) | Explain the role of SQL in database management systems. Write SQL queries to perform data definition, data manipulation, and data retrieval operations with examples | [10] | 3,4 | 2 | 5.2. 3.2. |
| (b) | What is Rapid Prototyping (RPT)? Explain any two methods of RPT with neat figures? | [10] | 3,4 | 2 | 5.2. 3.2. |

********** All the Best **********

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## END SEMESTER EXAMINATION ~~DEC 2025~~ / JAN2026

F.Y. M.Tech (C, CM, E) Sem I 21/26

| MTech | MTech Civil-Structural Engineering | MTech Civil-Construction Management | MTech Electrical - Power Electronics and Power System | MTech Mech-Machine Design | Duration : 3 hours<br>Max Points 100<br>Semester –I<br>Course Name : RMIPR |
|---|---|---|---|---|---|
| Course Code | PC-MTSE103 | PC-MTCM103 | PC-MTPX103 | PC-MTMD103 | |

**Instructions:**

- Question 1 is compulsory
- Attempt any four questions out of remaining six
- Draw neat diagrams
- Assume suitable data if necessary
- Standard data tables are permitted.

| Q.No. | Questions | Points | CO | BL | Module No. |
|---|---|---|---|---|---|
| Q1A | When to write a research paper? Why to write a research paper? With respect to a research paper writing provide specific guidelines based on following. (Consider Research of your own interest) :<br>• Title and Abstract<br>• Introduction<br>• Literature Review<br>• Methodology<br>• Results<br>• Discussion<br>• Conclusion<br>• References | 10 | CO1, CO2, CO3 | 5 | M4 |
| Q1B | Define what a research problem is and explain why its careful selection is crucial in the research process. Differentiate between a research topic, a research problem, and a research question. Give an example to illustrate your answer. | 10 | CO3 | 5 | M1 |

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## END SEMESTER EXAMINATION ~~DEC 2025~~ / JAN2026

| | | | | | |
|---|---|---|---|---|---|
| Q2A | • Mr X flies quite often from town A to Town B.<br>• He can use the Airport Bus which cost Rs25 But if he takes it there is a 0.08 Chance that he will miss the flight .<br>• The stay in hotel costs Rs270 with a 0.96 chance of being in time for the flight.<br>• For Rs 350 he can use taxi which will make 99 percent chance of being on time for the flight.<br>• If Mr X catches the plane on time he will conclude the business transaction that will produce the profit of Rs 10000/- . otherwise he will lose it .<br>• Which mode of transport should Mr X use ? | 10 | CO2, CO3 | 5 | M5 |
| Q2B | Imagine you are working on a research problem in your field (e.g., "Assessing the impact of Drone technology on Effectiveness on Construction Project Monitoring " *or* "Developing a sustainable concrete mix using industrial waste"*).*<br>a) Develop a detailed flowchart depicting the step-by-step research methodology for your chosen problem. Your flowchart should include stages from problem identification to data analysis and reporting.<br>b) Label each step clearly and provide a brief justification for why each step is included in the sequence. | 10 | CO2 | 3 | M1 |
| Q3A | • A population is divided into three strata so that N1 = 6500, N2 = 2500 and N3 = 3500.<br>• Respective standard deviations are: s1=16, s2=17 and s3=6.<br>• Respective Cost associated with strata Ci for Strata Ni<br>○ C1=4500, C2=1500, C3=1000<br>• How should a sample of size n = 89 be allocated to the three strata, if we want optimum allocation using disproportionate sampling design?<br>• Explain Interview techniques in detail. | 10 | CO2 CO3 | 4, 5 | M2, M3 |
| Q3B | Provide two real-world scenarios where 100% Inspection is essential. Justify why sampling would not be appropriate in these cases.<br><br>Define 100% Inspection and Sampling Inspection. Explain the primary objectives of each inspection method. Why would an organization choose one over the other? | 10 | CO2 | 3 | M3 |

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<table>
<tr><td>Q4A</td><td>Weight of 10 products are given in the table. Can we declare the variance of distribution of all wts. of all products from which the sample of 10 products was drawn is equal to 20 kgs? Test this at 5% and 1 % level of significance
<table>
<tr><td>Sr No</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Wt of Product</td><td>30</td><td>40</td><td>45</td><td>53</td><td>47</td><td>43</td><td>55</td><td>48</td><td>52</td><td>49</td></tr>
</table>
Explain Chi Square Test.</td><td>10</td><td>CO4</td><td>4</td><td>M3</td></tr>
<tr><td>Q4B</td><td>A maker of golf shirts has been tracking the relationship between sales and advertising dollars. Use linear regression to find out what sales might be if the company invested $65,000 in advertising next year.
<table>
<tr><td>Sr No.</td><td>Sales $ (Y) '000 $</td><td>Adv.$ (X) 000'</td></tr>
<tr><td>1</td><td>140</td><td>31</td></tr>
<tr><td>2</td><td>161</td><td>48</td></tr>
<tr><td>3</td><td>170</td><td>56</td></tr>
<tr><td>4</td><td>178</td><td>61</td></tr>
<tr><td>5</td><td>?</td><td>65</td></tr>
</table>
What do you mean by scatter Plot? What is the purpose of the same.</td><td>10</td><td>CO2<br>CO3</td><td>4</td><td>M3</td></tr>
<tr><td>Q5A</td><td>Briefly define a patent in your own words. What is its fundamental purpose from both the inventor's and society's perspective?<br>What are the universal criteria an invention must meet to be considered patentable? Briefly explain what each criterion means.<br>For each of the following, state which patentability criterion it most likely fails to meet and why:<br>• A new kind of wooden chair made from a common, well-known joint technique.<br>• A "perpetual motion machine" that claims to create energy from nothing.<br>• A mathematical formula or a discovered law of nature.</td><td>10</td><td>CO4</td><td>4</td><td>M6</td></tr>
<tr><td>Q5B</td><td>Numerical on Hypothesis Test – Z Test<br><br>We want to test on the basis of sample size 35 determinations and at 0.05 level of significance whether the thermal conductivity of a certain kind of plate is 0.34 units, as has been claimed. The mean of sample is 0.343. From the information gathered in similar studies ,</td><td>10</td><td>CO2,<br>CO3</td><td>4</td><td>M3</td></tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| | we can expect that the variability of such determinations is given by $\sigma = 0.01$ | | | | |
| Q6A | Prepare the guidelines for Case Study method of Research based on following<br><br>1. Definition & Nature.<br>2. When to Use<br>3. Research Questions<br>4. Case Selection<br>5. Design Types<br>6. Unit of Analysis<br>7. Data Collection Methods<br>8. Ethical Considerations<br>9. Data Analysis Process<br>10. Validity Strategies | 10 | CO3 | 4 | M1, M2 |
| Q6B | Points To Prepare Guidelines For Experimental Research<br><br>1. Research Question & Hypothesis<br>2. Variables Definition<br>3. Experimental Design<br>4. Population & Sampling<br>5. Control Groups<br>6. Randomization<br>7. Materials & Apparatus<br>8. Standardized Procedure<br>9. Data Collection Analysis<br>10. Ethical Approval & Consent | 10 | CO3, CO4 | 5 | M3 |
| Q7A | Define Copyright in your own words. How does copyright differ from patents and trademarks? What is the typical duration of copyright protection for literary, artistic, and musical works in India? | 10 | CO4 | 4 | M6 |
| Q7B | Define Trademark in your own words. How does a trademark differ from other forms of intellectual property like patents and copyrights? Provide three examples of well-known trademarks and explain what they protect (e.g., brand name, logo, slogan). | 10 | CO4 | 4 | M6 |

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**END SEMESTER December 2025 / ~~RE~~ - EXAM February 2026**

**Program: F.Y. Mechanical (M.Tech) Machine Design** Sem I **Duration: 3 Hour**

**Course Code: PE-MTMD02** **Maximum Points: 100**

**Course Name: Additive Manufacturing** **Semester: I**

**Notes: All questions are compulsory.**

| Q.No. | Questions | Points | CO | BL | Module No. |
|---|---|---|---|---|---|
| Q1) (A) | Explain the fundamental working principle of Additive Manufacturing (AM) with the aid of a neat, well-labeled illustrative diagram. Further, compare Additive Manufacturing with conventional subtractive machining by highlighting any five significant points of difference. | 10 | 2 | 2 | 1 |
| Q1) (B) | Define Rapid Tooling (RT). With the help of neat, well-labeled sketches, distinguish between Direct Rapid Tooling and Indirect Rapid Tooling. Compare the two methods in terms of their working principle, advantages, limitations, and industrial applications. | 10 | 3 | 2 | 1 |
| Q2) (A) | Describe the mechanical scanning system used in additive manufacturing. List its major components and explain how the scanning mechanism influences the accuracy and resolution of printed parts. | 10 | 4 | 2 | 2 |
| Q2) (B) | Explain the role of computer interfacing hardware in additive manufacturing machines. Trace the complete signal flow starting from the CAD model to the fabrication of the final prototype. | 10 | 2 | 3 | 2 |
| Q3) (A) | What is photopolymerization? Describe the process of photo-initiated polymerization used in stereolithography, explaining the role of monomers, photo initiators, and cross linking. | 10 | 3 | 2 | 3 |
| Q3) (B) | Write short notes on micro stereolithography. Explain its working principle, applications in biomedical and MEMS fields, and major limitations. | 10 | 3 | 2 | 3 |
| Q4) (A) | Describe the working of the fused deposition modeling system with the help of a neat sketch or flow diagram. | 10 | 3 | 2 | 4 |
| Q4) (B) | Explain the principle and working steps of the laminated object manufacturing system with a suitable process description. | 10 | 3 | 2 | 4 |
| Q5) (A) | Compare selective laser sintering, three-dimensional printing, laser engineered net shaping, and electron beam melting processes with | 10 | 3 | 4 | 5 |

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# SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute) Munshi Nagar, Andheri (W) Mumbai – 4

**END SEMESTER January 2026/ ~~RE - EXAM~~ February 2026**

F.Y. M.Tech

7/11/26

**Program: M.Tech Machine Design** **Duration: 03 Hours.**

**Course Code: PE-MTMD12** **Maximum Points: 100**

**Course Name: Advanced Engineering Materials** **Semester: I**

**Notes:**

1. **Question no 1 is compulsory**
2. Attempt any **four questions** from the remaining six questions.
3. If necessary **assume suitable** data with justification
4. Draw **neatly labeled sketches** wherever required.

| Q. No. | Questions | Points | CO | BL | Module No. |
|---|---|---|---|---|---|
| 1A | Draw the Fe–C equilibrium phase diagram and clearly label the compositions, phases, and critical transformation temperatures. On the same diagram, locate the invariant point at which a single liquid phase transforms simultaneously into two different solid phases. Using the horizontal isotherm corresponding to this transformation, apply the lever rule to determine the relative proportions of the two solid phases formed from the liquid. Analyze the significance of this transformation by explaining its effect on the resulting microstructure of cast irons. | 10 | 3 | 4,5 | 3 |
| 1B | A relatively large glass plate is subjected to a tensile stress of 48 MPa. If the specific surface energy and the modulus of elasticity of the glass are 0.4 J/m$^2$ and 75 GPa, respectively, determine the maximum permissible length of a surface flaw that can exist without causing fracture. Further, Analyze the reason for premature fracture in brittle materials by examining the role of stress concentration at crack tips and its effect on crack initiation. | 10 | 4 | 3,4 | 4 |
| 2A | Critically analyze how advanced materials such as biomaterials, smart materials, and additive manufacturing materials are designed and selected to meet application-specific functional requirements. In your answer, discuss the roles of biocompatibility, stimulus–response behavior, and process-dependent property control, with suitable examples. | 10 | 1 | 4,5 | 1 |
| 2B | Draw a neat diagram of the materials life cycle showing the flow from raw material extraction to final disposal. Explain each stage briefly and discuss why recycling is important in reducing environmental impact and conserving natural resources. | 10 | 6 | 4 | 7 |

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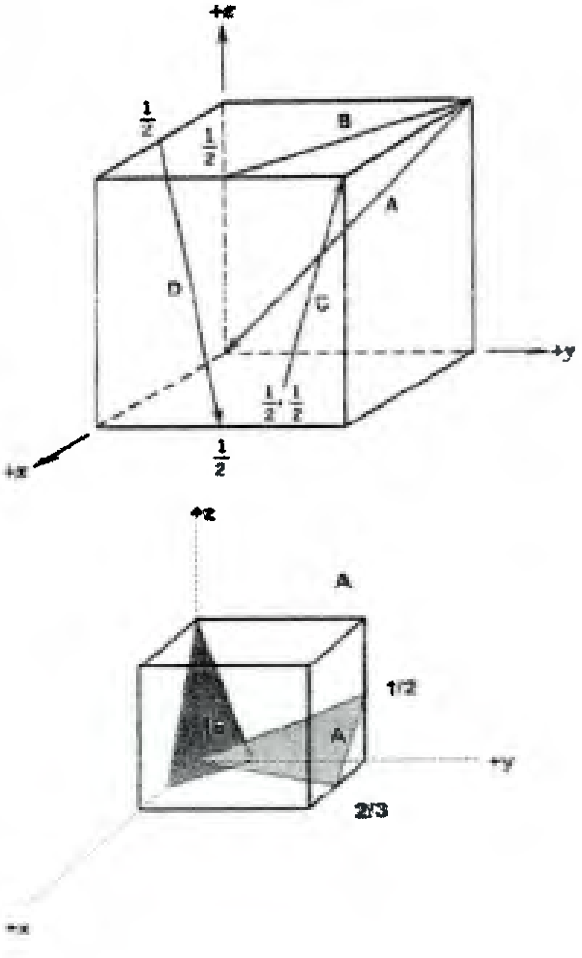
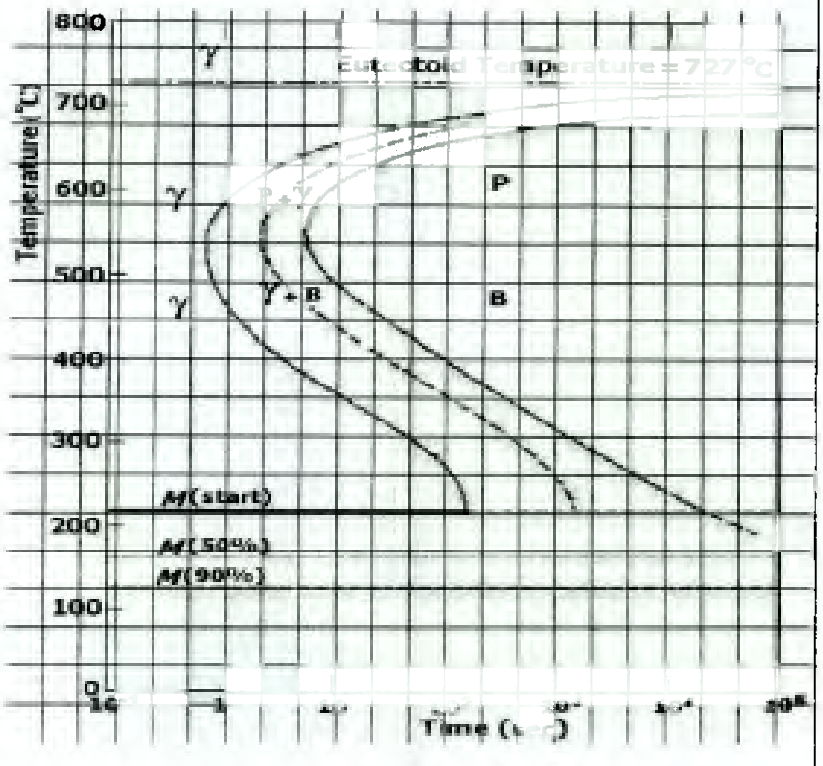
## END SEMESTER Januarv 2026/ ~~RE – EXAM~~ Februarv 2026

| | | | | | |
|---|---|---|---|---|---|
| 3 A | Determine the Miller indices for the directions and the planes shown in the following unit cell:[Note: provide the stepwise calculations for the given problem]     | 10(6 +4) | 2,4 | 5 | 1 |
| 3B | A single crystal of silver is subjected to a uniaxial tensile load applied along the [ 1 $\bar{1}$ 0] crystallographic direction. Considering that plastic deformation occurs by slip on the (1 $\bar{1}$ $\bar{1}$ ) [ 0$\bar{1}$ 1] slip system, analyze the crystallographic conditions for slip and determine the magnitude of the applied tensile stress required to initiate yielding. The critical resolved shear stress for silver is given as 6 MPa. In your answer, compute the Schmid factor and justify the activation of the given slip system. Additionally, illustrate a cubic crystal clearly indicating the slip plane, slip direction, and loading axis. | 10 | 1,2 | 2,3 | 2 |
| 4A | Discuss each case of the heat treatment process of Fe-0.65% C eutectoid steel rapidly cooled from a preheated temperature of 860$^0$C (>727$^0$C) as follows [**NOTE:** Analyze the resulting microstructures, evaluate the properties of the final product, and justify the suitability of each process.]<br>1. rapidly cool to 630°C, hold for30 seconds, rapidly cool to | 10 | 3,4 | 4 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| | 400°C hold for $10^4$ s and quench to room temperature.<br>2. Rapidly cool to 450°C, hold for $10^4$ seconds, then quench to room temperature.<br>3. Rapidly cool to 270 °C, hold for 8s, rapidly cool to 100 °C, quench to room temperature;<br>  | | | | |
| **4B** | Analyze the fracture behavior of engineering materials by discussing the macroscopic features associated with ductile fracture and the sequence of events leading to the characteristic cup-and-cone fracture profile. Further, examine the contrasting characteristics of brittle fracture in terms of deformation behavior, crack propagation, fracture surface appearance. | 10 | 5 | 3,4 | 4 |
| **5A** | Describe the objectives and mechanisms of thermal processing of steels. Explain annealing, normalizing, quenching, and tempering, and discuss how cooling rate and phase transformations influence hardness, strength, and toughness. | 10 | 5 | 4 | 5 |
| **5B** | Apply band theory to explain the electrical behavior of intrinsic and extrinsic semiconductors, and analyze how doping controls conductivity. Further, discuss the phenomenon of superconductivity with reference to critical temperature and engineering applications | 10 | 4,5 | 4 | 6 |

**END SEMESTER January 2026/~~RE - EXAM~~ February 2026**

| | | | | | |
|---|---|---|---|---|---|
| **6A** | Classify ceramics based on their composition and applications, and explain the general processing route used for ceramic materials that involves powder preparation, forming, and high-temperature densification. Further, analyze how processing parameters influence density, grain growth, and the resulting mechanical properties of ceramic components. | 10 | 5 | 4 | 5 |
| **6B** | Discuss the thermal properties of materials with reference to heat capacity, thermal expansion, and thermal conductivity. Analyze how these properties influence thermal stress development and material selection in engineering design. | 10 | 5,2 | 3 | 6 |
| **7A** | Draw a two-dimensional crystal lattice showing the insertion of an extra half-plane of atoms and identify the resulting edge dislocation. Using a Burgers circuit, determine the magnitude and direction of the Burgers vector. Further, differentiate between edge dislocation and screw dislocation with respect to lattice distortion and Burgers vector orientation. | 10 | 2 | 4,5 | 2 |
| **7B** | Draw a simple block diagram representing the input–output concept of a product life cycle. Indicate the main inputs such as materials and energy, and the outputs such as useful products, waste, emissions, and effluents. Explain how this input–output analysis helps engineers reduce waste and design environmentally friendly products. | 10 | 6 | 3,4 | 7 |

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## End Semester Examination December 2025

Program: First Year M. Tech Mechanical Engineering (Machine Design) Duration: 3 Hour

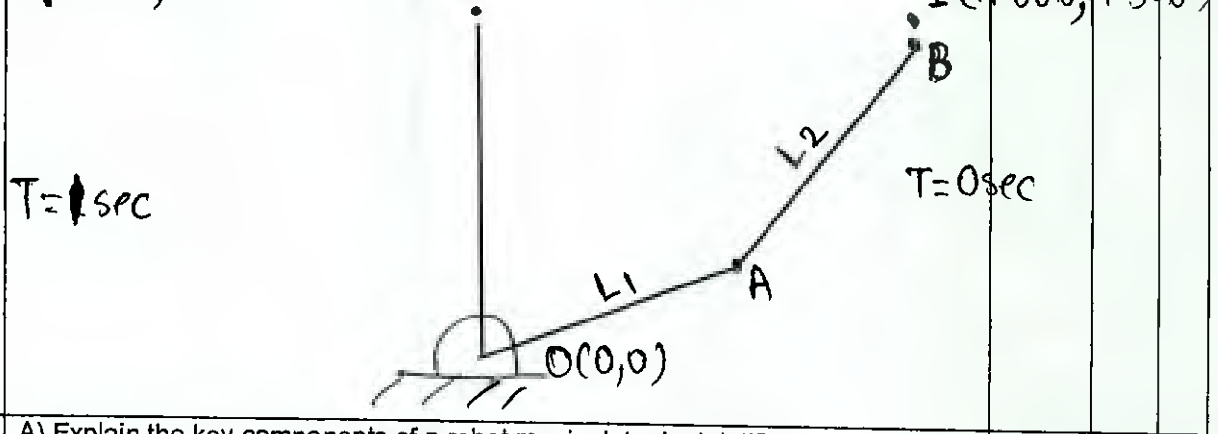
Course Code: PE-MTMD14 Maximum Points: 100

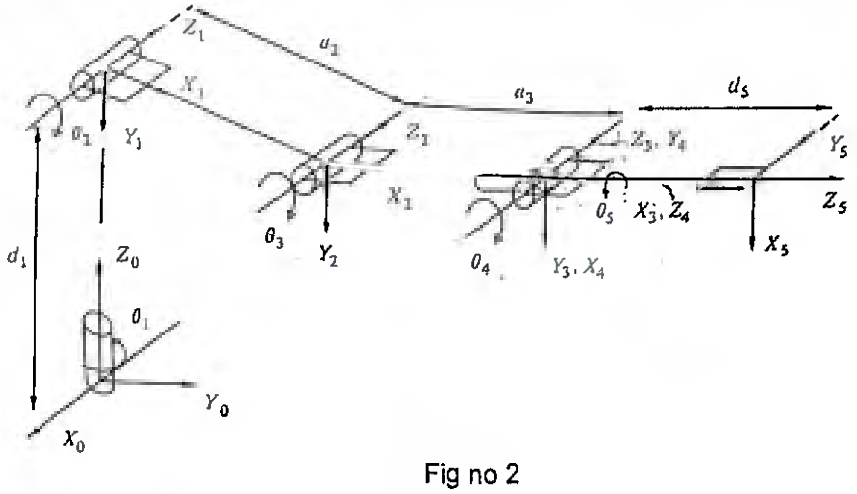
Course Name: Robotics Semester: I

9/11/25

**Notes:**

- Solve any 05 questions.
- Answers to all sub questions should be grouped together.
- Assume suitable data if necessary justify the same and state the assumptions clearly.

| Q NO | Question | Points | CO | M |
|---|---|---|---|---|
| Q1. | A) In a Fastner manufacturing industry, A planar 2-R manipulators is installed to move an cast metals parts from point 'I' (1.366,1.366) to point 'F' (-1.366,1.366) through 2 second time slot. Initial, final position of links and fixed mechanism parameter data provided in fig. no. 01. [15 M]<br>Find the following.<br>1) Generalized equation for joint space angle's to define motion<br>2) Calculate Cartesian space co-ordinates of end effector point 'B' at regular time interval of 0.5 seconds and prepare the total table?<br>B) Also state number of boundary conditions and their expressions if mechanism is kinematically consistent, continuous motion through via points (0,1.366) and motion of mechanism is coordinated? [5 M]<br>F(-1.366, 1.366) I(1.366, 1.366)<br>  <br> | 20 | 3 | 4 |
| 2. | A) Explain the key components of a robot manipulator in detail? | 10 | 1 | 1 |
| | B) Compare Cartesian robots with SCARA robots and give its sketch? | 10 | 1 | 1 |
| 3. | A) Write a short note on internal state sensor and external state sensor using any one example of each? | 10 | 2 | 3 |
| | B) Give Comparison of the table between Fixed and Flexible automation systems? | 10 | 2 | 3 |
| 4. | A) Explain how slip sensors function in robotic grippers. Mention one limitation and one improvement technique for slip Sensors | 10 | 1 | 2 |

| | | | | |
|---|---|---|---|---|
| | B) Differentiate between DC motors and Stepper motors in tabular form? | 10 | 2 | 2 |
| Q5 | A) Find the composite rotation matrix representing the following: a) rotation of α about u axis, b) rotation of β about v axis and c) rotation of γ about w axis? | 10 | 3 | 5 |
| | B) Enlist important constraints involved in trajectory planning of end effector? Why Cubic polynomial is generally used to define motion of end effector in joint space co-ordinate? | 10 | 3 | 5 |
| Q6 | For the Mini-mover robot structured coordinated frame shown in Fig 2, construct the following a) table for joint parameters b) Component of $R_0^5$ matrix? Joint distance between link 0 and 1 is "4 feet", Length of Link 2 and 3 is "8 feet" each, Link 3 and 4 is concurrent links, Joint distance between link 4 and 5 is "1 feet".<br>  <br><br>Fig no 2 | 20 | 3 | 6 |

Bharatiya Vidya Bhavan's

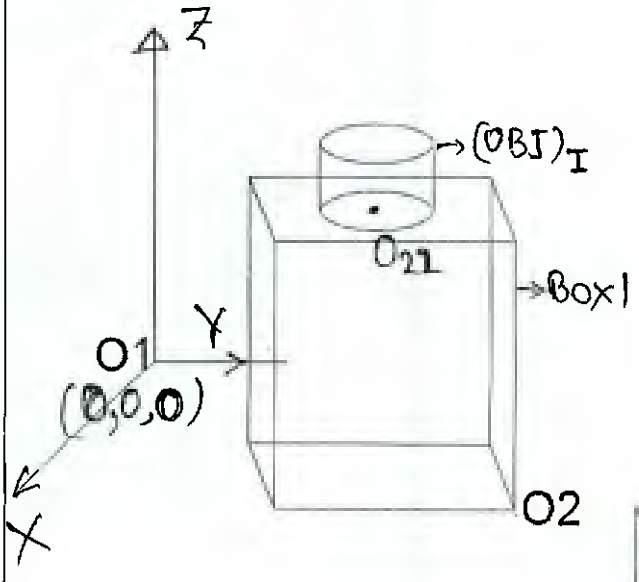
# SARDAR PATEL COLLEGE OF ENGINEERING

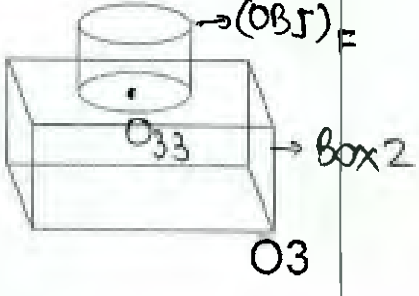
(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

**End Semester Examination December 2025**

| Q7 | Find the position and orientation of the end effector (in terms of transformation matrices) at Initial and Final position of for the system shown below. (Fig 3) | 20 | 4 | 7 |
|---|---|---|---|---|




$(OBJ)_I$ & $(OBJ)_F$ are Initial & Final positon of object. Figure 3

X Y Z

$O_1 = (0, 0, 0)$

$O_2 = (350, 350, 0)$

$O_3 = (850, 850, 0)$

Box 1 = (100, 100, 300)

Box 2 = (100, 100, 100)

Object = Φ50 × 50 long (OBJ)

$O_{22} = (300, 300, 300)$

$O_{33} = (800, 800, 100)$