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21EME15

## First Semester B.E./B.Tech. Degree Examination, Feb./Mar. 2022 Elements of Mechanical Engineering

Time: 3 hrs.

Max. Marks: 100

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.  
2. Use of Steam tables is permitted.**

### Module-1

- 1 a. Explain the role of Mechanical Engineering in Industries and Society. (06 Marks)  
 b. Explain formation of steam at constant pressure with T – h diagram. (06 Marks)  
 c. Calculate the specific volume and enthalpy of 5kg of steam at 1.2 MPa  
     i) When the steam is 12% wet      ii) When the steam is superheated at 360°C. (08 Marks)

OR

- 2 a. Determine the density of 1 kg of steam initially at a pressure of 10 bar absolute, having a dryness fraction of 0.78. If 500 kJ of heat is added at constant pressure, determine the condition and internal energy for the final state of steam. Given specific heat of superheated steam = 2.1 kJ/kg. K. (10 Marks)  
 b. Explain with neat sketch, construction and working of a nuclear power plant. (10 Marks)

### Module-2

- 3 a. Write short note on Smart material and shape memory alloys. (08 Marks)  
 b. Give comparison of welding, soldering and brazing. (08 Marks)  
 c. Give brief classification of Metals. (04 Marks)

OR

- 4 a. Explain briefly fibre reinforced and metal matrix composites. (08 Marks)  
 b. Give a brief introduction of TIG and MIG welding. (08 Marks)  
 c. Brief heat transfer in automobile radiators. (04 Marks)

### Module-3

- 5 a. Explain the working of two stroke petrol engine with neat sketch. (08 Marks)  
 b. Define the following with respect to refrigeration and air conditioning :  
     i) COP      ii) Ton of refrigeration      iii) Refrigeration      iv) Refrigeration effect. (08 Marks)  
 c. List out components of Electrical and Hybrid vehicles. (04 Marks)

OR

- 6 a. What is a Refrigerant? What are its characteristics? (08 Marks)  
 b. Briefly explain applications of IC engines in Power generation. (08 Marks)  
 c. Mention advantages and disadvantages of EVs and hybrid vehicles. (04 Marks)

### Module-4

- 7 a. A simple gear train consists of 3 gears. The number of teeth on the driving gear is 60, on the roller gear is 40 and on the driven gear is 80. If the driving gear rotates at 1200 rpm, find speed of driven gear and also the velocity ratio. Sketch the arrangement of gear drive. (04 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- b. Explain different types of belt drives with their applications. (08 Marks)  
c. Briefly explain Robot Anatomy with neat figure. (08 Marks)

OR

- 8 a. It is required to transmit a power of 20kW between 2 parallel shafts by means of belt drive arrangement. The speeds of driving and driven shafts are 150 rpm and 250 rpm respectively. Distance between parallel shafts is 2.7m. Driven pulley diameter is 60cm. Coefficient of friction between belt and pulley is 0.25. Determine the tensions and length of the belt for cross drive arrangement. (08 Marks)  
b. Classify Robot configurations. Explain any two with neat sketch. (08 Marks)  
c. Define Machines and Mechanisms. (04 Marks)

Module-5

- 9 a. Explain the construction and working of milling machine and applications. (08 Marks)  
b. Explain Lathe Operations - Turning , Knurling , Boring , Taper turning. (08 Marks)  
c. What are the components of CNC? (04 Marks)

OR

- 10 a. Explain Construction and working of lath. (08 Marks)  
b. Explain the concepts of smart manufacturing and industrial IOT. (08 Marks)  
c. Give a brief introduction of modern machining tools and techniques. (04 Marks)

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# Re: Sir, Regarding Modification of Scheme and Solutions

"Dr M S Govinde Gowda"  
<msggowda1964@gmail.com>

June 1, 2022 11:00 AM

To: boe@vtu.ac.in

Dear Sir,

PFA for the corrected and approved scheme and solution of **21EME15** for your notice and further needful from your end.

With regards

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**Dr. M.S.Govinde Gowda**

**Chairman, BOE, Mechanical Board, VTU  
and**

**Dean(Academics)**

**ATME College of Engineering**

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On Thu, May 26, 2022 at 4:51 PM <boe@vtu.ac.in> wrote:

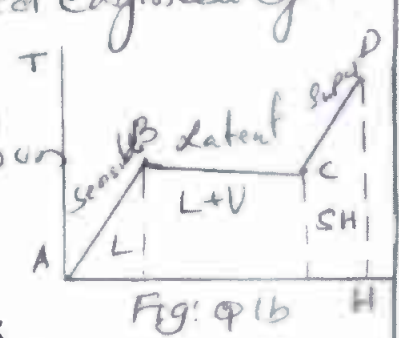
**"APPROVED"**  
   
**Registrar (Evaluation)**  
Visvesvaraya Technological University  
BELAGAVI - 590018  



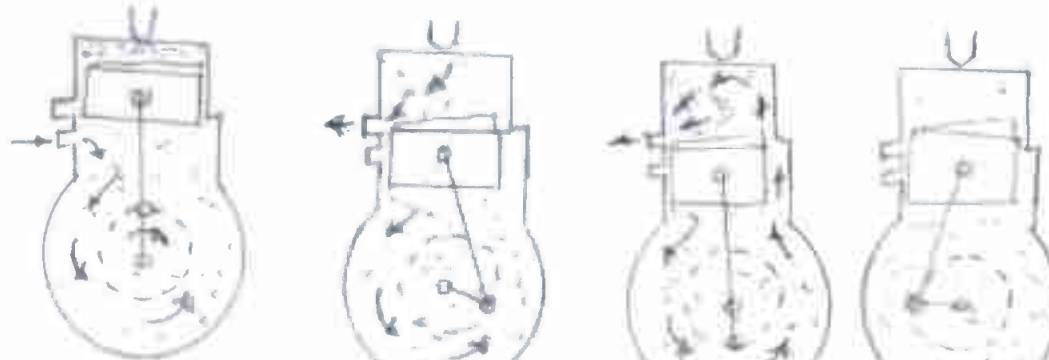


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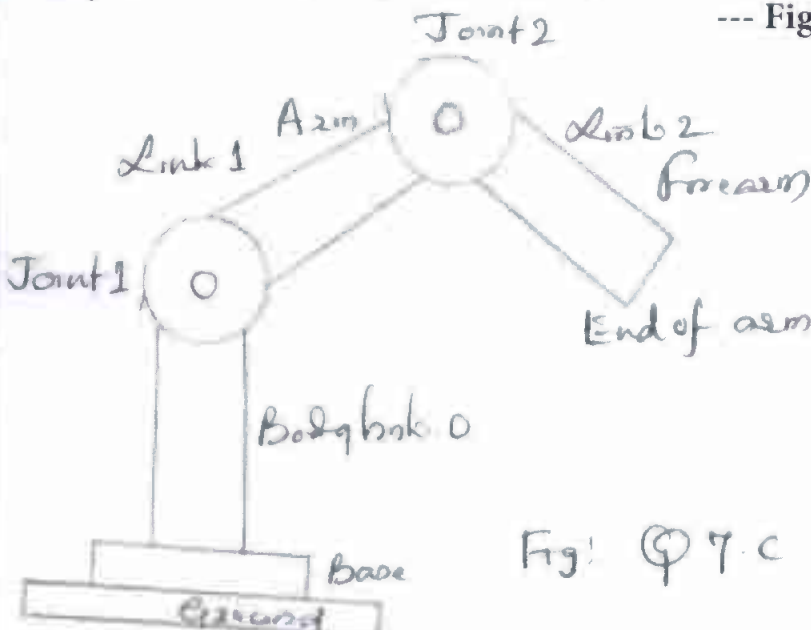
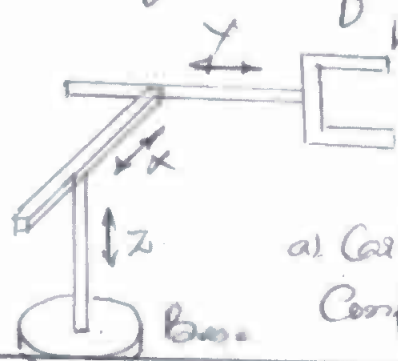
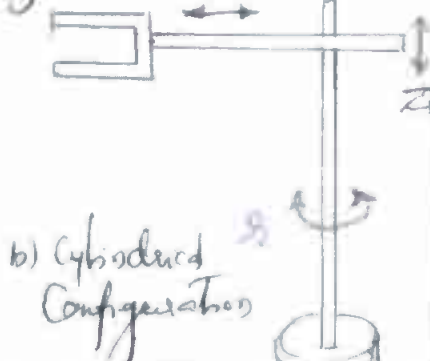
Scheme & Solutions  
Subject Title: Elements of Mechanical Engineering Subject Code: 21EME15/25

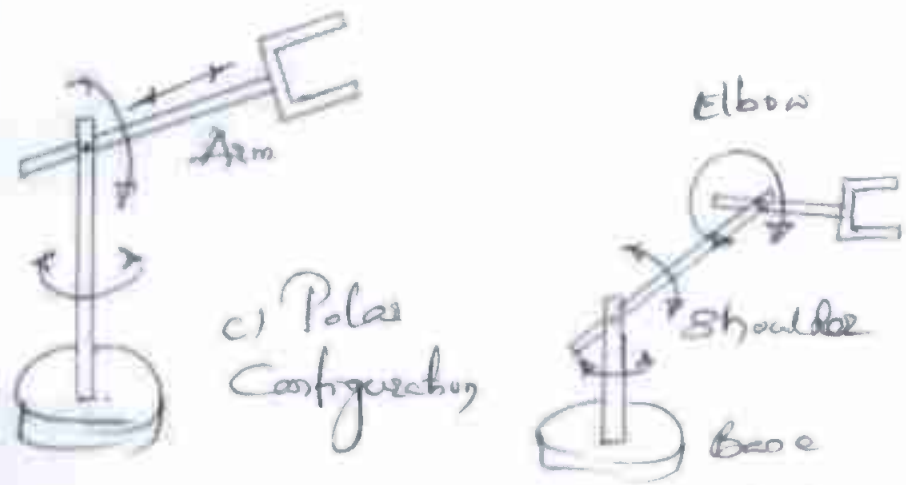
| Question Number | Solution  | Marks Allocated |
|-----------------|---|-----------------|
| 1 a             | Explanation on role of mechanical Engineering<br>- in industry<br>- in society  | 03<br>03        |
| b               | Explanation on steam formation<br>T-h diagram   | 04<br>02        |
| c               | <p>Steam at 12-1 wet:</p> $v_w = 2v_g = 0.14362 \text{ m}^3/\text{kg}$ $= 0.718 \text{ m}^3 \text{ for } 5 \text{ kg}$ $h_w = h_f + xh_{fg} = 2544.58 \text{ kJ/kg}$ $= 12722.9 \text{ kJ for } 5 \text{ kg}$ <p>Steam at superheated at 360°C:</p> $v_{sup} = \frac{t_{sup}}{t_{sat}} \times v_g = 0.224 \text{ m}^3/\text{kg}$ $= 1.12 \text{ m}^3 \text{ for } 5 \text{ kg}$ $h_{sup} = h_g + C_{ps}(t_{sup} - t_{sat}) = 3144 \text{ kJ/kg}$ $= 15720 \text{ kJ for } 5 \text{ kg}$ | 02<br>02<br>02  |
| 2 a             | <p>When <math>x &lt; 1</math></p> $\rho_w = \frac{1}{2v_g} = 6.6 \text{ kg/m}^3$ <p>On heat addition, the condition is super heated state <math>t_{sup} = 207^\circ\text{C}</math></p> $h_1 = h_w = h_f + xh_{fg} = 2333.2 \text{ kJ/kg}$ $v_{sup} = 0.206 \text{ m}^3/\text{kg} \quad h_2 = h_{sup}$ $u_{sup} = h_{sup} - 100 \rho \cdot v_{sup} = 2627.3 \text{ kJ/kg}$   | 05<br>05        |
| b               | Explanation<br>neat sketch  | 06<br>04        |
| 3 a             | State on - smart materials<br>- shape memory alloys   | 04<br>04        |
| b               | Comparisons -- Any 4 points   | 08              |
| c               | Classification  | 04              |



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| Question Number | Solution   | Marks Allocated |
|-----------------|--|-----------------|
| 4 a             | Explanation on — fibre reinforced composites   | 04              |
|                 | — metal matrix composites  | 04              |
| b               | Introduction of — TIG welding (Fig -2M & Explan-2M)  | 04              |
| c               | — Mier welding (Fig -2M & Explan-2M)   | 04              |
| 5 a             | Brief explanation of two stroke petrol engine  | 04              |
| b               | Next sketch  | 04              |
|                 |  <p>a) Intake Ignition      b) Exhaust      c) Intake to cylinder &amp; exhaust      d) Compression in cylinder</p> |                 |
| b               | Each definition 2 marks  | 08              |
| c               | Advantages & Disadvantages   | 04              |
| 6 a             | Refrigerant explanation Characteristics. Thermodynamic physical chemical   | 02<br>02<br>02  |
| b               | Complete explanation   | 08              |
| c               | EVs & Hybrid vehicles - Advantages & Disadvantages   | 02<br>02        |
| 7 a             |  <p>Driving      Idler      Driven</p> <p>Fig. Q7.9</p>   | 02              |
|                 | <p>sketch</p> $\frac{n_3}{n_1} = \frac{T_1}{T_3}$ $n_3 = 900 \text{ rpm}$ $VR = \frac{n_3}{n_1} = 384$   | 01<br>01        |


| Question Number     | Solution  | Marks Allocated                                   |
|---------------------|---|---|
| <p>7 b</p> <p>c</p> | <p>Explanation on different types of belt drives<br/>Applications</p> <p>Explanation of anatomy</p> <p>--- Fig-4M &amp; Expln-4M</p>  <p>Fig: 7.c</p>  | <p>02</p> <p>02</p> <p><del>04</del></p>          |
| <p>8 a</p> <p>b</p> | <p>For cross belt drive</p> $L = 2C + \pi(r_1 + r_2) + \frac{(r_1 - r_2)^2}{C} = 8.15 \text{ m}$ <p>Belt tensions: <math>\frac{T_1}{T_2} = e^{\mu\theta}</math></p> $\theta = \left[ 180 + 2 \sin^{-1} \left( \frac{r_1 - r_2}{C} \right) \right] \frac{\pi}{180} \text{ radians} = 3.743 \text{ rad}$ <p>Power <math>P = \frac{(T_1 - T_2)v}{1000}</math> kW</p> <p>From above <math>T_1 = 1644.7 \text{ N}</math></p> <p><math>T_2 = 4192.3 \text{ N}</math></p> <p>a) Cartesian Configuration</p> <p>b) Cylindrical Configuration</p>   | <p>02</p> <p>02</p> <p>02</p> <p>02</p> <p>02</p> |

| Question Number | Solution   | Marks Allocated                |
|-----------------|--|--------------------------------|
|                 |  <p>c) Polar Configuration</p> <p>d) Jointed arm configuration</p> |                                |
| 8 c             | <p>Any two sketches to be considered</p> <p>definition of - Mechanism</p> <p>Mechanism</p>   | <p>04.</p> <p>02</p> <p>02</p> |
| 9 a             | <p>Milling machine construction</p> <p>Working</p> <p>Application</p>  | <p>03</p> <p>03</p> <p>02</p>  |
| b               | <p>Turning</p>   | <p>02</p>                      |
| c               | <p>Cutting</p>   | <p>02</p>                      |
| b               | <p>Boring</p>  | <p>02</p>                      |
| c               | <p>Taper turning</p>   | <p>02</p>                      |
| c               | <p>Components of CNC</p>   | <p>04</p>                      |
| 10 a            | <p>Construction of Lathe</p> <p>Working</p>  | <p>04</p> <p>04</p>            |
| b               | <p>Concept of - smart manufacturing</p> <p>- Industrial IoT</p>  | <p>04</p> <p>04</p>            |
| c               | <p>Introduction of modern machining tools and techniques</p>   | <p>04</p> <p>04</p>            |

Approved by

  
 Dr. M.S. Govinde Gowda  
 Chairman,  
 BOE, Mechanical Board, VTU.

\* APPROVED \*

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 Registrar (Evaluation)