

34 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

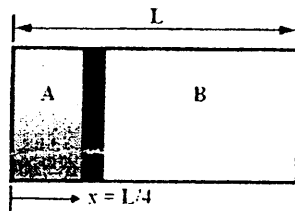
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, BAG, BAM	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

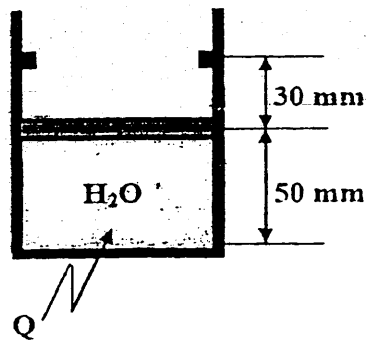
Subject: - Fundamental of Thermodynamic and Heat Transfer (ME452)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. Define thermodynamic property. Differentiate between intensive and extensive properties with examples. [4]
2. In what respect the heat and work interactions are (i) similar and (ii) dissimilar? [4]
3. Define quality and moisture content. Derive an expression for specific volume of a two phase mixture in terms of quality. [4]
4. Define a cycle. Explain first law of thermodynamics for control mass undergoing cyclic process. Write down statements of first law for power cycle and refrigeration cycle. [6]
5. Define entropy. Derive and expressions for change in entropy for reversible heat transfer and reversible work transfer process. [6]
6. Explain the working principle of Brayton cycle with corresponding processes on P-v and T-s diagrams. [6]
7. Differentiate between steady state and unsteady state heat transfer. Derive an expression for steady state heat transfer through a composite cylinder consisting of three layers. [6]
8. A cylinder with a total volume of 2 m^3 has a movable piston as shown in figure below, when the piston is at one fourth of the length, both sides have the same specific volume of $8\text{ m}^3/\text{kg}$. Determine the specific volumes of both sides when the piston is at middle of the cylinder. [6]



9. The frictionless piston shown in figure below has a mass of 20 kg and a cross sectional area of 78.48 cm^2 . Heat is added until the temperature reaches 400°C . If the quality of the H_2O at the initial state is 0.2 , determine: [8]
 - i) The initial pressure
 - ii) The mass of H_2O
 - iii) The quality of the system when the piston hits the tops
 - iv) The final pressure and
 - v) The total work transfer [Take $P_{\text{atm}} = 100\text{ kPa}$, $g = 9.81\text{ m/s}^2$]



10. Air enters a compressor operating at steady state at 100 kPa, 300 K and leaves at 1000 kPa, 400 K, with a volumetric flow rate of $1.5 \text{ m}^3/\text{min}$. The work consumed by the compressor is 250 kJ per kg of air. Neglecting the effects of potential and kinetic energy, determine the heat transfer rate in KW. [Take $R = 287 \text{ J/kgK}$ and $C_p = 1005 \text{ J/kgK}$] [8]
11. A refrigerator having a COP of 4 maintains the freezer compartment at -3°C by removing heat at a rate of 10800 kJ/kg and rejects heat to the surroundings at 27°C . Determine the power input to the refrigerator and compare it with minimum theoretical power input. If the electricity cost 10/kWh, determine the actual and minimum theoretical cost per day for effective operation of 12h/day. [8]
12. At the beginning of a compression stroke of an air standard diesel cycle having a compression ratio of 16, the temperature is 300 K and the pressure is 100 kPa. If the cut off ratio for the cycle is 2, determine (a) the thermal efficiency (b) the mean effective pressure. [Take $\gamma = 1.4$, $R = 287 \text{ J/kg.k}$]. [8]
13. A thick-walled tube of stainless steel ($k=19 \text{ W/m}^\circ \text{C}$) with 2 cm inside diameter and 1 cm thickness is covered with a 3 cm layer of asbestos insulation ($k=0.2 \text{ W/m}^\circ \text{C}$). If the inside wall temperature of the pipe is maintained at 600°C and outside wall temperature of the insulation is maintained at 100°C , Calculate the heat loss per unit length. Also calculate the tube insulation interface temperature. [6]

Table 1: Properties of SATURATED WATER – Pressure Table

P kPa	T °C	v_f m³/kg	v_{fg} m³/kg	v_g m³/kg	u_f kJ/kg	u_{fg} kJ/kg	u_g kJ/kg	h_f kJ/kg	h_{fg} kJ/kg	h_g kJ/kg	s_f kJ/kg.K	s_{fg} kJ/kg.K	s_g kJ/kg.K
100	99.632	0.001043	1.6933	1.6943	417.41	2088.3	2505.7	417.51	2257.6	2675.1	1.3027	6.0562	7.3589
101.32	100.00	0.001043	1.6727	1.6737	418.96	2087.1	2506.1	419.06	2256.6	2675.7	1.3069	6.0476	7.3545
125	105.99	0.001048	1.3742	1.3752	444.25	2068.9	2513.2	444.38	2240.7	2685.1	1.3741	5.9100	7.2841
150	111.38	0.001053	1.1584	1.1595	467.02	2052.4	2519.4	467.18	2226.2	2693.4	1.4338	5.7894	7.2232

Table A2: Properties of Superheated Steam

P kPa	T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg.K
600	(158.86)	(0.3156)	(2567.3)	(2756.7)	(6.7601)
	200	0.3520	2638.5	2849.7	6.9658
	250	0.3938	2720.3	2936.6	7.1806
	300	0.4344	2800.5	3061.2	7.3716
	350	0.4742	2880.9	3165.4	7.5459
	400	0.5137	2961.9	3270.2	7.7076
	450	0.5529	3044.1	3375.9	7.8591
	500	0.5920	3127.7	3482.9	8.0022
	550	0.6309	3212.7	3591.2	8.1380
	600	0.6697	3299.3	3701.2	8.2676

P kPa	T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg.K
800	(179.44)	(0.2404)	(2576.6)	(2768.9)	(6.6625)
	200	0.2607	2630.2	2838.8	6.8151
	250	0.2931	2714.8	2949.3	7.0373
	300	0.3241	2796.6	3055.9	7.2319
	350	0.3544	2877.9	3161.4	7.4084
	400	0.3843	2959.6	3267.0	7.5713
	450	0.4139	3042.2	3373.3	7.7237
	500	0.4433	3126.1	3480.7	7.8673
	550	0.4726	3211.3	3589.4	8.0036
	600	0.5018	3298.1	3699.6	8.1335

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr., BAM	Pass Marks	32
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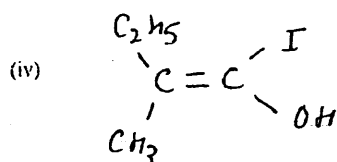
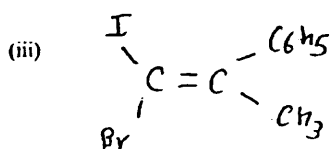
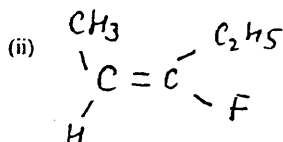
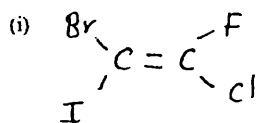
Subject: - Engineering Chemistry (SH453)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- What are the criteria for buffer system? How many grams of sodium benzoate should be added to 160 mL of 0.13 M benzoic acid solution to obtain a buffer with a pH of 4.3? [pKa value of benzoic acid is 4.2] [1+4]
- What is single electrode potential? Can its absolute value be measured? If not, how is the problem solved? Describe with a suitable example. [1+4]
- What is meant by catalytic poisoning? Explain intermediate compound formation theory of catalysis referring suitable example. [2+3]
- How is global warming caused due to air pollution? Write the consequences of global warming and its possible remedies. [2+3]
- What do you mean by point and non point sources of water pollutants? Give an account of primary and secondary processes of waste water treatment to control water pollution. [2+3]
- What is biodegradable polymer? Write applications of carbon reinforced polymers and chalcogenide glasses in engineering. [5]
- How your acquaintance to polyurethanes and Bakelite. [2.5+2.5]
- What are transition elements? Why are all the transition elements not considered as typical transition elements? Explain the electronic configuration of the first transition elements. [1+1+3]
- Why do transition elements show variable oxidation states? Explain with reference to 3d series elements. [1+2]
 - Explain why compounds of Ti^{3+} are coloured but those of zinc are colourless. [2]
- What do you understand by a chelate and a chelating ligand? Describe Sidewick theory of co-ordination compounds with an example. Write down the IUPAC names of the following compounds. [2+2+1]
 - $Na_3[Al(C_2O_4)_3]$
 - $[Co(NH_3)_4Cl_2]^+$
- How does valence bond theory explain the formation of $[Fe(CN)_6]^{3-}$. Also explain whether this complex is inner or outer orbital and why? [3+2]
- What is plastic explosive? How can you prepare TNT from benzene? Why does detonator require for the explosion of TNT? [1+2+2]
- What are lubricants? Mention the functions of lubricants. [2.5]
 - How is paint applied on wooden articles? [2.5]

14. a) What is geometrical isomerism? Why is trans-isomer more stable than Cis-isomer?
Why is geometrical isomerism not possible in propene? [3]

b) Find out E or Z configuration in the following molecules. [2]



15. What is meant by S_N reaction? Explain the mechanism for the nucleophilic reaction that proceeds with and inversion of configuration. Why inversion product predominates more than retention product is S_N1 reaction. [1+3+1]

16. What do you mean by elimination reaction? Write the mechanism for —
dehydrohalogenation in primary alkylhalide. Show your acquaintance to Saytzeff's rule. [1+2+2]

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Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT BIE, B. Agri., BAM	Pass Marks	32
Year / Part	I / II -	Time	3 hrs.

Subject: - Engineering Chemistry (SH453)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) What is standard hydrogen electrode? Give cell notation of Cu electrode with it.
 b) From the given electrode couple $E^{\circ}_{Fe/Fe^{++}} = 0.44$ volt, $[Fe^{++}] = 0.5$ M and $E^{\circ}_{Ag/Ag^+} = -0.80$ volt, $[Ag^+] = 0.2$ M. Write the (i) electrode reaction (ii) net cell reaction (iii) cell notation (iv) EMF of Fe-Ag cell and spontaneity of the cell reaction. [2+3]
2. a) What is buffer action? Describe the mechanism of acidic buffer solution with a suitable example.
 b) 60 mL of 0.5 M acetic acid is mixed with 40 mL of 0.25 M sodium hydroxide solution. What will be the p^H of the mixture? (Given $K_a = 1.85 \times 10^{-5}$) [3+2]
3. What are promoters? Describe the adsorption theory of catalysis with a suitable example. Point out criteria of catalysts used for industrial purpose. [1+3+1]
4. a) What do you mean by chlorofluorocarbons? Mention their photolytic reactions in the upper atmosphere.
 b) Why are the oxides of sulphur and nitrogen assumed as air pollutants? [3+2]
5. What are the major sources of water pollution? Mention their adverse effects and possible remedies. [1+2+2]
6. Nylon and Teflon are different polymers. Explain. Give the preparation and uses of epoxy resin. [3+2]
7. What are chalcogenide glasses? Give an account of preparation and uses of network polymers of sulphur. [1+4]
8. a) Why are transition elements called so? Are all d-block elements called transition elements? Justify your answer with reason. [1+2]
 b) Why do transition elements form significant number of complexes? [2]
9. Explain. Why?
 - i) Paramagnetic properties increase from Sc to Mn and then decrease to Zn.
 - ii) Zn^{2+} salts are white while Cu^{2+} salts are coloured
 - iii) Fe^{3+} compounds are more stable than Fe^{2+} . [2.5+1.5+1]
10. $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ are both octahedral but show marked difference in their magnetic properties. Explain. [2.5+2.5]

-
11. Differentiate between double salt and complex salt. Write the application of Werner's theory of co-ordination compound. [3+2]
 12. a) Write the characteristics of a good paint and explain the method of application of paint in galvanized iron.
b) What are lubricating oils? Write the chief functions of lubricants. [3+2]
 13. Write the points of difference between high explosives and plastic explosives. Mention the preparation and applications of TNT. [2.5+2.5]
 14. All the diastereomers are stereoisomers but all the stereoisomers are not diastereomers. Explain. Describe the chemical method for resolution of racemic mixture. [3+2]
 15. Differentiate between nucleophile and electrophile. Explain the mechanism of dehydrohalogenation of 2-Bromo -2- methylpropane. [2+3]
 16. Write the reaction mechanism of SN^2 reaction with a suitable example. How does it differ from SN^1 reaction? [3+2]

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Exam.	Back		
Level	BE	Full Marks	80
Programme	ALL (Except B. Arch.)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Engineering Mathematics II (SH451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- State Euler's Theorem for homogeneous function of two variables. If $u = \tan^{-1}\left(\frac{x^3 + y^3}{x + y}\right)$
then show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \sin 2u$. [1+4]
- Obtain the maximum value of xyz such that $x + y + z = 24$. [5]
- Evaluate: $\int_0^a \int_{\sqrt{a^2 - y^2}}^a \frac{y^2}{\sqrt{y^4 - a^2 x^2}} dy dx$ by changing order of integration. [5]
- Evaluate: $\iiint_R (2x + y) dx dy dz$ where R is closed region bounded by cylinder $z = 4 - x^2$ and planes $x = 0, y = 0, y = 2, z = 0$. [5]
- Show that $\frac{x+4}{3} = \frac{y+6}{5} = \frac{z-1}{-2}$ and $3x - 2y + z + 5 = 0 = 2x + 3y + 4z - 4$ are coplanar lines and find the point of intersection. [5]
- Show that the shortest distance between the lines $x + a = 2y = -12z$ and $x = y + 2a = 6z - 6a$ is $2a$. [5]
- Obtain the equation of tangent plane to sphere $x^2 + y^2 + z^2 + 6x - 2z + 1 = 0$ which passes through the line $3(16 - x) = 3z = 2y + 30$ [5]
- Find the equation of cone with vertex at $(3, 1, 2)$ and base $2x^2 + 3y^2 = 1, z = 1$ [5]

OR

Find the equation of the right circular cylinder whose guiding curve is the circle:
 $x^2 + y^2 + z^2 - x - y - z = 0, x + y + z = 1$

- Solve the initial value problem: $y'' - 4y' + 3y = 10e^{-2x}, y(0) = 1, y'(0) = 3$ [5]
- Solve the differential equation by power series method: $y'' - y = 0$ [5]

11. Solve in series, the Legendre's equation $(1-x^2)y''-2xy'+n(n+1)y=0$ [5]

OR

Prove the Bessel's function $J_{\frac{3}{2}}(x) = \sqrt{\frac{2}{\pi x}} \left(\frac{\sin x}{x} - \cos x \right)$

12. Prove that $\left[\begin{matrix} \vec{a} \times \vec{b} & \vec{c} \times \vec{d} & \vec{e} \times \vec{f} \end{matrix} \right] = \left[\begin{matrix} \vec{a} & \vec{b} & \vec{d} \end{matrix} \right] \left[\begin{matrix} \vec{c} & \vec{e} & \vec{f} \end{matrix} \right] - \left[\begin{matrix} \vec{a} & \vec{b} & \vec{c} \end{matrix} \right] \left[\begin{matrix} \vec{d} & \vec{e} & \vec{f} \end{matrix} \right]$ [5]

13. Prove that the necessary and sufficient conditions for the vector function \vec{a} of scalar variable t to have constant direction is $\vec{a} \times \frac{d\vec{a}}{dt} = 0$ [5]

14. Find the angle between the normal to the surfaces given by: $x \log z = y^2 - 1$ and $x^2y + z = 2$ at the point $(1,1,1)$ [5]

15. Test the convergence of the series: [5]

$$x + \frac{3}{5}x^2 + \frac{8}{10}x^3 + \frac{15}{17}x^4 + \dots + \frac{n^2-1}{n^2+1}x^n + \dots, x > 0.$$

16. Find the interval and radius of convergence of power series: [5]

$$\frac{1}{1.2}(x-2) + \frac{1}{2.3}(x-2)^2 + \frac{1}{3.4}(x-2)^3 + \dots + \frac{1}{n(n+1)}(x-2)^n + \dots$$

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TRIBHUVAN UNIVERSITY

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2075 Baishakh

Exam.

Back

Level

BE

Full Marks

40

Programme

All (Except B. Arch)

Pass Marks

16

Year / Part

I / II

Time

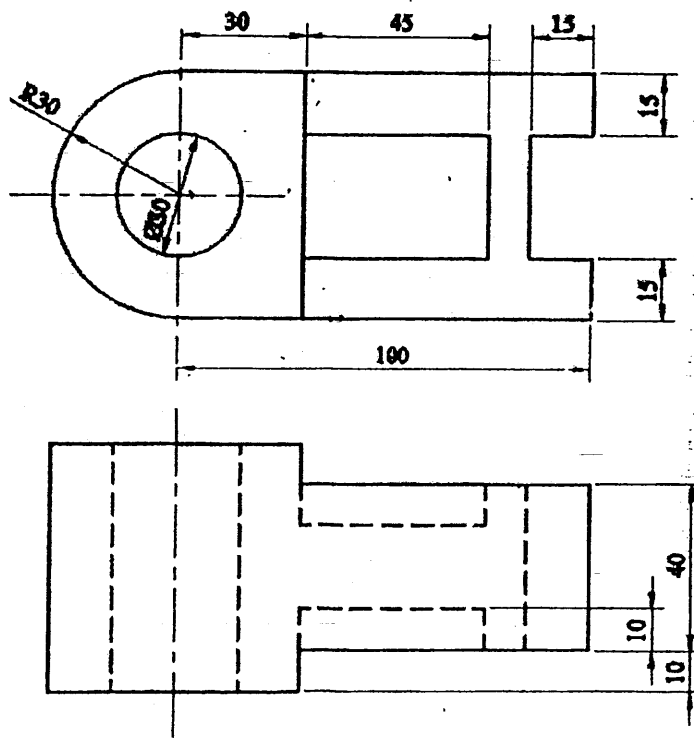
3 hrs.

Subject: - Engineering Drawing II (ME451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
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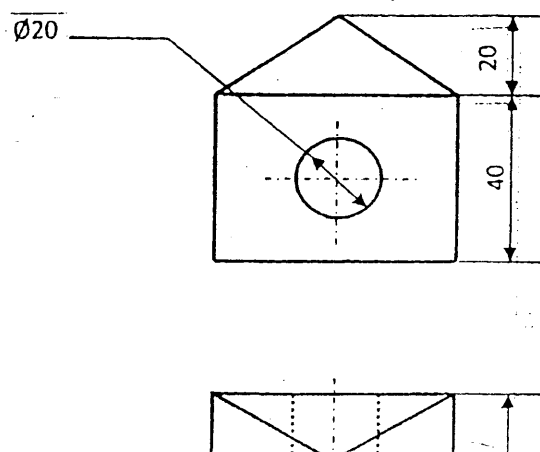
1. Draw an isometric view from the given orthographic views as shown in figure below:

[10]

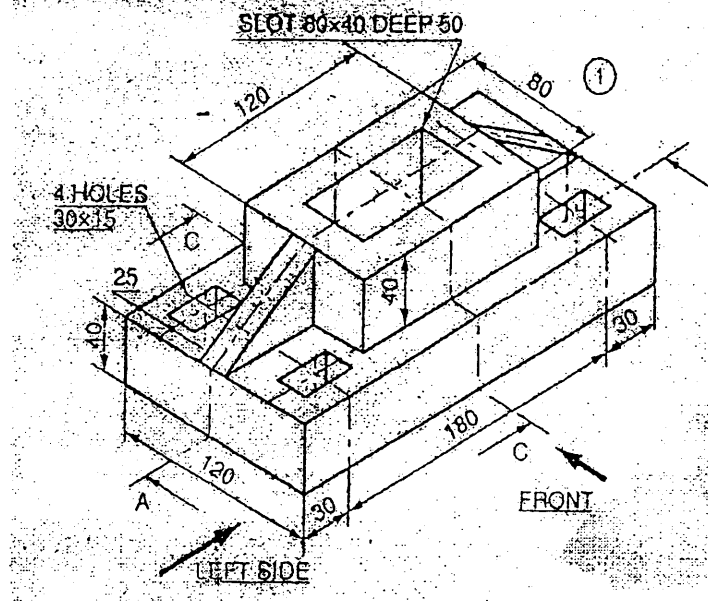


2. Draw the angular perspective view of figure below:

[5]



3. Orthographic projection of the object is shown in figure below. Draw the sectional view at section A-A. [5]



OR

Draw the standard symbols for the following:

- External Thread
- First angle projection
- Projection welding
- Nipple
- Material removed by milling
- Maximum material condition
- Thermistor
- Three phase motor
- Channel
- Church

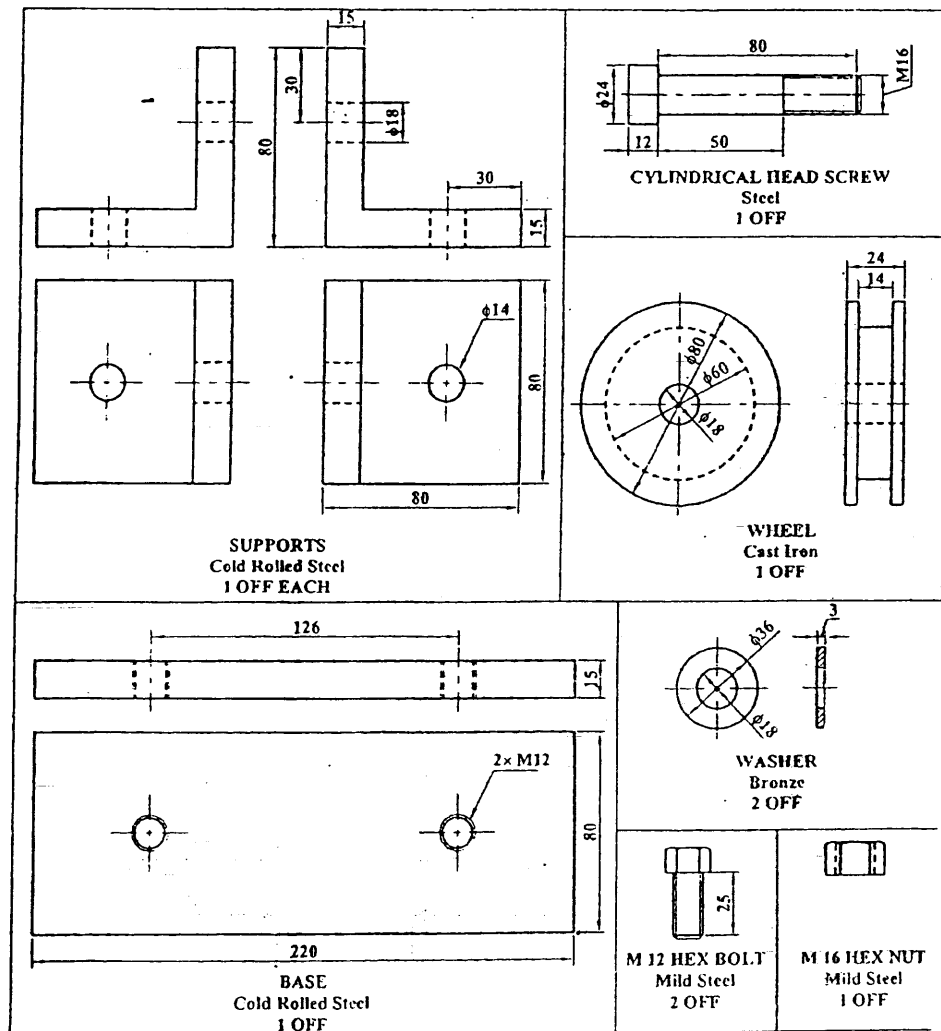
4. Sketch the top view and sectional front view for double riveted double strap chain butt joint. [5]

OR

Make complete fit analysis of the following symbols 100H11/p7; fundamental deviations for H and p are 0.00 mm and 0.037 mm respectively. ITG for 11 and 7 are 0.22 mm and 0.035 mm respectively. Indicate type of fit, allowance and type of system.

5. Draw the assembled sectional front view from the following detail drawings shown in figure below.

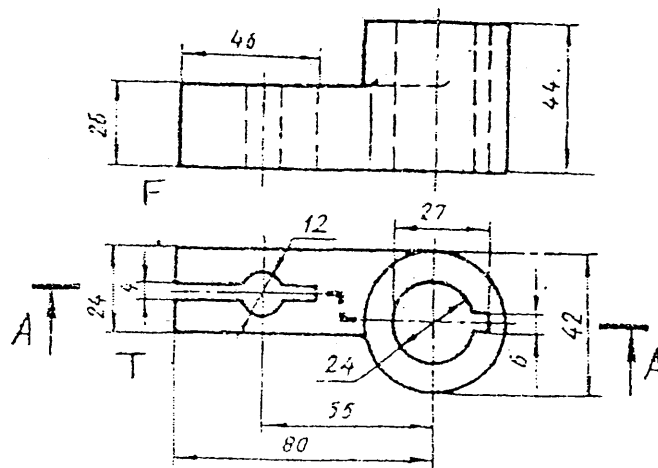
[15]



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-

2. A solid square prism of side base 30 mm and height 40 mm rests with its base on the ground and one of the rectangular faces inclined at 30 degree to the PP. the nearest vertical edges touches the pp. the Station point is 80 mm in front of the pp, 80 mm above the ground and opposite to the nearest vertical edge that touches the pp. Draw the perspective view and indicate main dimensions. [5]
3. Draw sectional front view from the component as shown in figure below. [5]



4. Draw the front view and full sectional top view of double riveted double strap chain type butt joint. [5]

OR

Determine the limits of dimensions and types of fit designed by 50H8/d9. Assume fundamental deviation for H and d as 0 micrometers above the size and 0.080 mm below the basic size line respectively and international tolerance grade for 8 and 9 as 0.039 mm and 0.062 mm respectively.

5. Draw the assembled sectional front view from the detail drawing in figure 5 (attach with Question) [15]

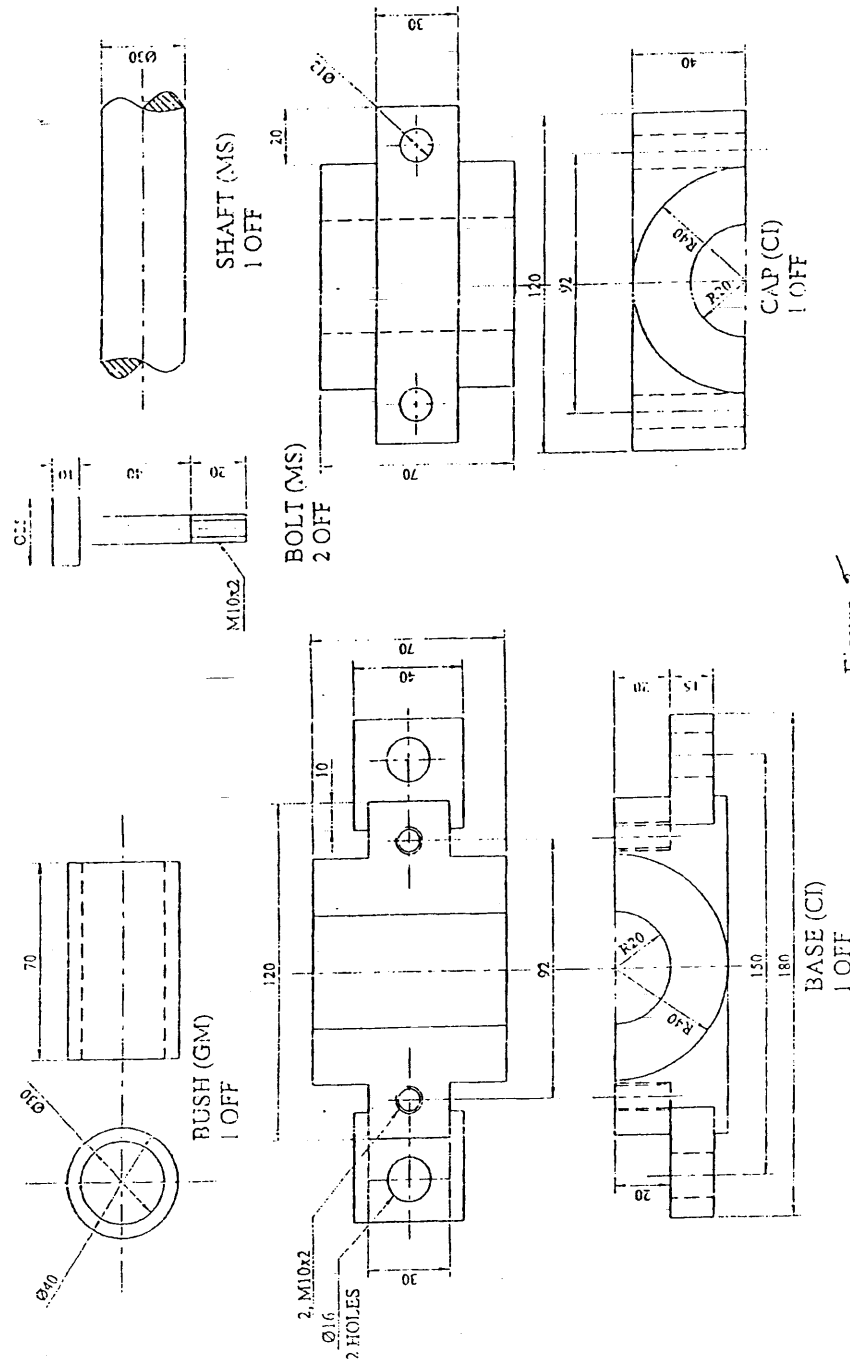


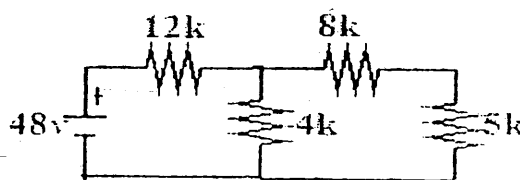
Figure 5

Exam.	Bacl.		
Level	BE	Full Marks	80
Programme	All (Except B. Arch)	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Basic Electronics Engineering (EX451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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1. Determine V_{th} , R_{th} and the current through $5\text{ K}\Omega$ resistor using Thevenin's theorem. [4]



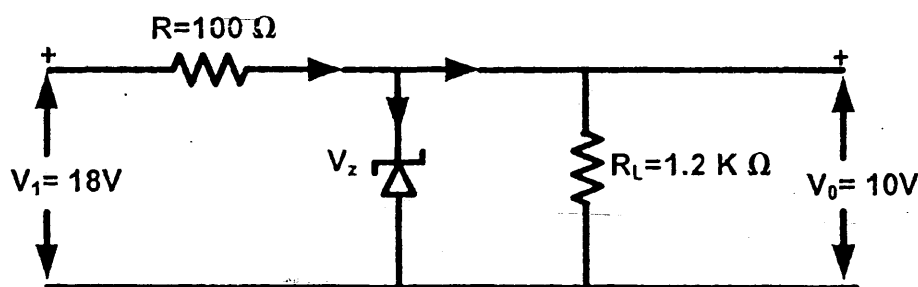
2. What do you mean by a filter circuit? Explain the operation of RC low pass filter with its transfer function and frequency response. [4]
3. Explain large signal models of PN junction diode. [4]
4. Explain the working principle of full wave bridge rectifier with necessary diagrams and expressions. [4]
5. Draw the DC load line and determine the Q point of the voltage divider biased transistor circuit having $V_{CC} = 20\text{V}$, $R_C = 2\text{K}$, $R_1 = 20\text{k}$, $R_2 = 10\text{k}$, $R_E = 4\text{k}$, $\beta = 100$. [6]
6. Describe the construction and working principle of n-channel depletion type MOSFET with necessary diagrams. [6]
7. Explain the operation of CMOS inverter with necessary diagram. [4]
8. Describe the working principle of square wave generator circuit using operational amplifier. [4]
9. What do you mean by virtual short circuit in OP amp? Draw the circuit diagram of the inverting integrator and show that the output is proportional to the time-integral of the input. [2+2+2]
10. State Barkhausen criteria for oscillation. Draw Wein bridge oscillator circuit to generate sine wave and derive the frequency of the generate sine wave. [2+2+2]
11. Explain working principle of optical fiber. List out the advantages of optical fiber communication over copper cable communication. [2+4]
12. Write short notes: (any two) [2×3]
- i) Data Logger
 - ii) Digital Multimeter (DMM)
 - iii) Regulated Power Supply
13. What is an antenna? Explain any two properties of the antenna. [2+2]
14. Simplify the expression using K-Map, $F(A,B,C) = A'B + BC' + AC'$. [4]
15. Explain the operation of JK flip-flop with necessary diagrams and characteristic table. [6]
16. What is multiplexer (MUX) Explain 4:1 Multiplexer. [6]

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Subject: - Basic Electronics Engineering (EX451)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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1. What is Active and Passive Component? Define transconductance and voltage gain with reference to BJT. [2+4]
2. Draw the circuit diagram of RC High pass filter and explain its operation with the help of frequency dependent response at the output. [5]
3. Find the Zener Current in the given circuit when $R_L = 1.2 \text{ K}\Omega$. Assume $V_Z = 10 \text{ V}$. [5]



4. What is clipper and clamper circuit? [2]
5. Draw emitter feedback bias circuit of BJT by labeling all the circuit components. Find I_C and V_{CE} in the circuit if $V_{CC} = +12 \text{ V}$, $R_B = 430 \text{ k}\Omega$, $R_C = 2 \text{ k}\Omega$, $R_E = 1 \text{ k}\Omega$ and $\beta = 50$. [2+4]
6. Draw the circuit diagram of differential amplifier using BJT. [2]
7. Describe the working principle of n-channel enhancement type MOSFET. [6]
8. Mention any four properties of ideal Op-amp. Derive the expression of voltage gain of non-inverting amplifier using Op-amp. [2+4]
9. State Barkhausen criteria. Draw the circuit diagram of square wave generator and explain how it works. [2+4]
10. Draw the circuit diagram of Wien Bridge oscillator. [4]
11. Differentiate between following communication systems. [3+3]
 - i) Wired and wireless communication system
 - ii) Broadcasting and communication
12. What are the advantages and disadvantages of optical communication system? [4]
13. Write short notes on: (any two) [2×3]
 - i) Oscilloscope
 - ii) Data logger
 - iii) Regulated power supply using IC
14. State DeMorgan's theorem. Subtract $(1111)_2$ from $(1110)_2$ using 2's complement method. [3+3]
15. Simplify an expression $F(A,B,C,D) = \sum(1,3,7,9,11,14,15)$ by using K-map. [4]