SE SEM-III (OLD) NOV-DEC-2013

MECH/AUTO

Sub:- PP-I

Date: 20-12-13

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Con. 5601-13. **LJ-10412**

(OLD COURSE)

(3 Hours) **[Total Marks : 100**

N.B. : (1) Questions No. **one** is **compulsory**.
(2) Attempt any **four** questions form the remaining **six** questions.
(3) **Figures** to the **right** indicate **Full** marks.
(4) Draw neat sketches wherever required.
(5) Assume suitable data if required.

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1. Write short notes on the following (any **four**) **20**
   (i) Dressing and Truing of Grinding wheels
   (ii) Friction welding
   (ii) Dye penetrant test
   (iv) Pattern allowances
   (v) Ultrasonic machining
   (vi) Taper turning methods.

2. (a) Explain with the help of neat sketch construction and working of a lathe machine. **10**

   (b) Write the difference between Up-milling and Down-milling. **5**

   (c) Define cutting speed, feed and depth of cut in drilling. **5**

3. (a) Why risers are used? Explain principles of riser design and gating system. **10**

   (b) Explain the Identification causes and remedial measures of the following casting defects. **10**
   (i) Scab
   (ii) Blow holes
   (iii) Shrinkage cavities
   (iv) Mismatch
   (v) Porosity.

4. (a) Explain centreless grinding operation. **5**

   (b) Sketch and Explain 'crank and slotted link mechanism' in shaper. **8**

   (c) Explain the principle, working and Application of com process. **7**

5. (a) Explain 'Sintering' process of powder metallurgy. **5**

   (b) Explain 'Radiographic' as Non-destructive method of Inspection. **7**

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(c)Explain the following terms w.r.t. Grinding wheel. **8**

(i) Grit
(ii) Grade
(iii) Structure
(iv) Band

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6. (a) Write the difference between soldering and brazing. **5**

(b) Explain MIG welding process. **7**

(c) Explain OXY-acytylene Gas welding. Also explain different types of flams with sketches. **8**

7. (a) Sketch and explain 'Electric Arc' Furnace. State its advantages and applications. **10**

(b) Differentiate between capstan and Turret lathe. **5**

(c) Sketch and explain following operations **5**

(i) Counterboring
(ii) Reaming

SE SEM-III (old) OTR NOV-DEC-2013

MECH/AUTO Sub:- MD Date: 16-12-13

5 : Legal Con code-1-JP

Con. 9876–13. (OLD COURSE) LJ–10382

(4 Hours) [Total Marks : 100

N.B.: (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from the **remaining**.
(3) **Use** your judgement for any **unspecified** dimensions.
(4) **Use** only drawing sheets for **answering**.
(5) **Use first angle** method of **projections** for **answering**.
(6) **Neatness** and **cleanliness** will be considered while **assessing**.

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1. (a) Draw only with free hand the sketches for any two of the following (two views each): 10
   i) Step cone pulley
   ii) Spigot and socket cotter joint
   iii) Split muff coupling
   (b) Draw I.S. conventional representation of assembly of threaded parts in external or sectional views 03
   (c) Explain in general the steps required to be followed in preparing assembly drawing from details and vice versa 07
2. (a) A vertical cone of diameter 100 mm and axis 100 mm is penetrated by a vertical square prism, having edges of base 45mm. The axis of the square prism is 10 mm away from the axis of the cone and the plane containing both the axes is perpendicular to the V.P. The rectangular face of the square prism makes 30 degrees with V.P. Draw the front view and the top view showing the curves of intersections. 10
   (b) A square prism with side of base 40 mm and height 70 mm is kept on the H.P. on its base, with two vertical faces making 20° with V.P. A cylinder of diameter 40 mm penetrates completely through the prism, in such a way that the axis of the cylinder is parallel to V.P. and bisects the axis of the prism at right angle. Draw the projections showing curves of intersection. 10
3. (a) Draw free hand sketches for any two of the following (in two views):- 10
   i) Fast and loose pulley
   ii) Indexing drilling jig
   iii) Plummer block
   (b) Define terminology of limit system 10
4. (a) Fig. 1 shows two views of the object. Draw the given views and add an auxiliary view from the direction of arrow 'X' 12

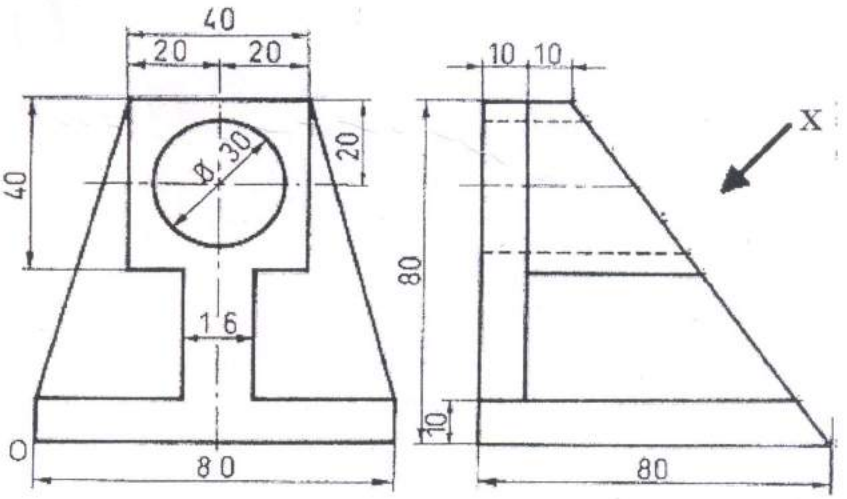
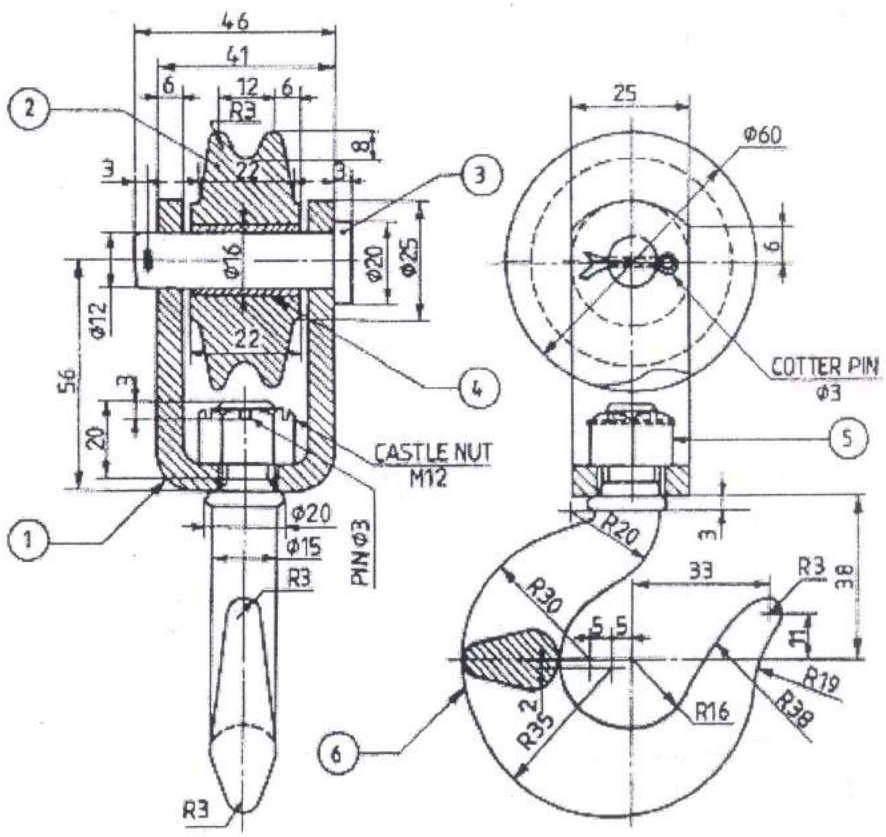


Fig.1

(b) Fig.2 shows two views of assembly of Crane Hook. Draw the following:

1) Strap
   - i) Front View 02
   - ii) Side view 02

2) Pulley
   - i) Front view 02
   - ii) Side view 02



Parts List

Part No.	Qty.	Name	Matl.
1	1	Strap	HCS
2	1	Pulley	CI
3	1	Pin	MS
4	1	Bush	Bronze
5	1	Castle nut	MS
6	1	Hook	FS

Crane hook

Fig.2

5. Fig.3 shows detailed drawing of locomotive connecting rod end . Assemble all parts and draw the following views of assembly
   - i) Half sectional Front View 12
   - ii) Top view 08

6. Fig.4 shows detailed drawing of spring loaded relief valve. Assemble all parts and draw the following views of assembly
   - iii) Sectional Front View 12
   - iv) Top view 08

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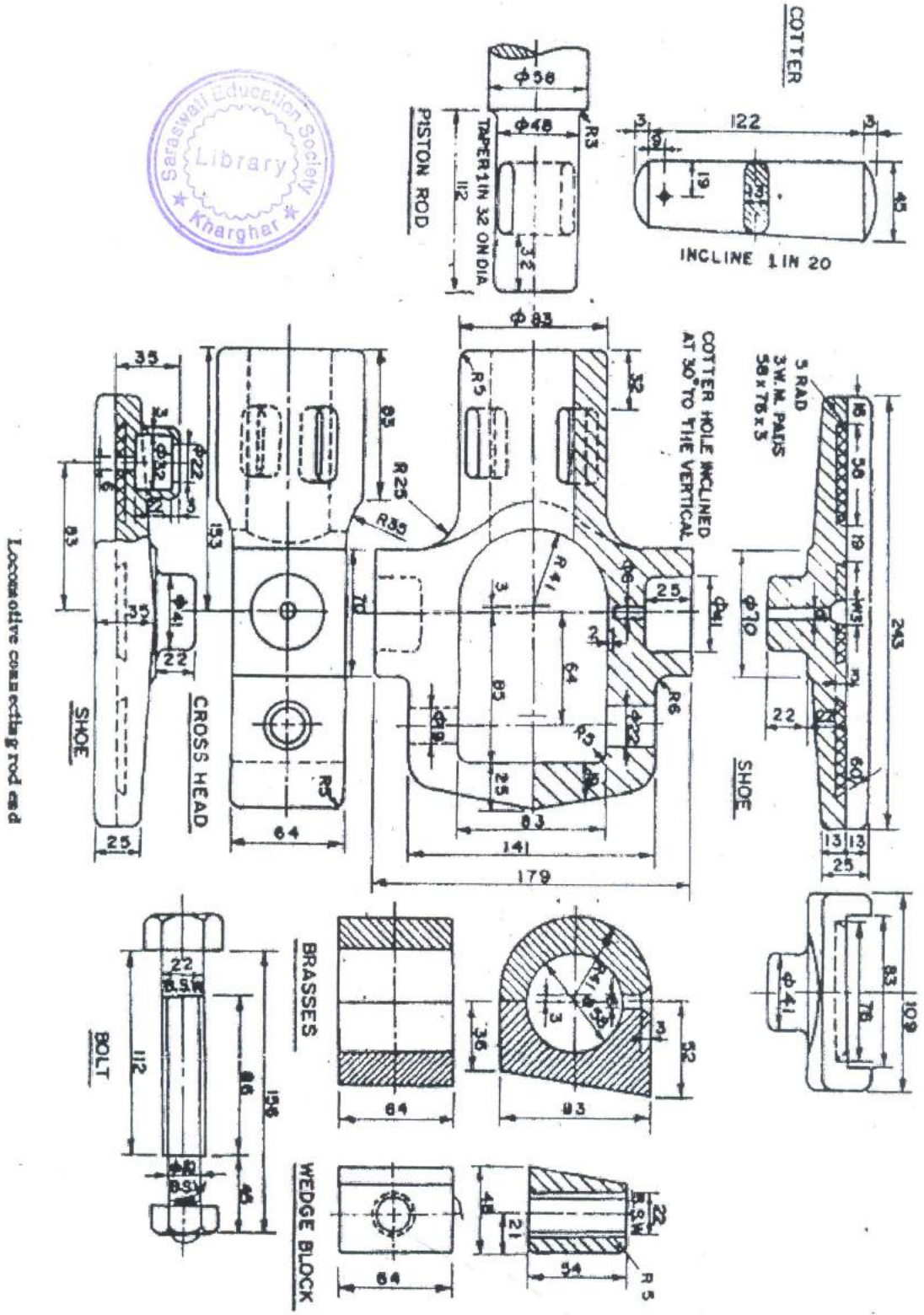
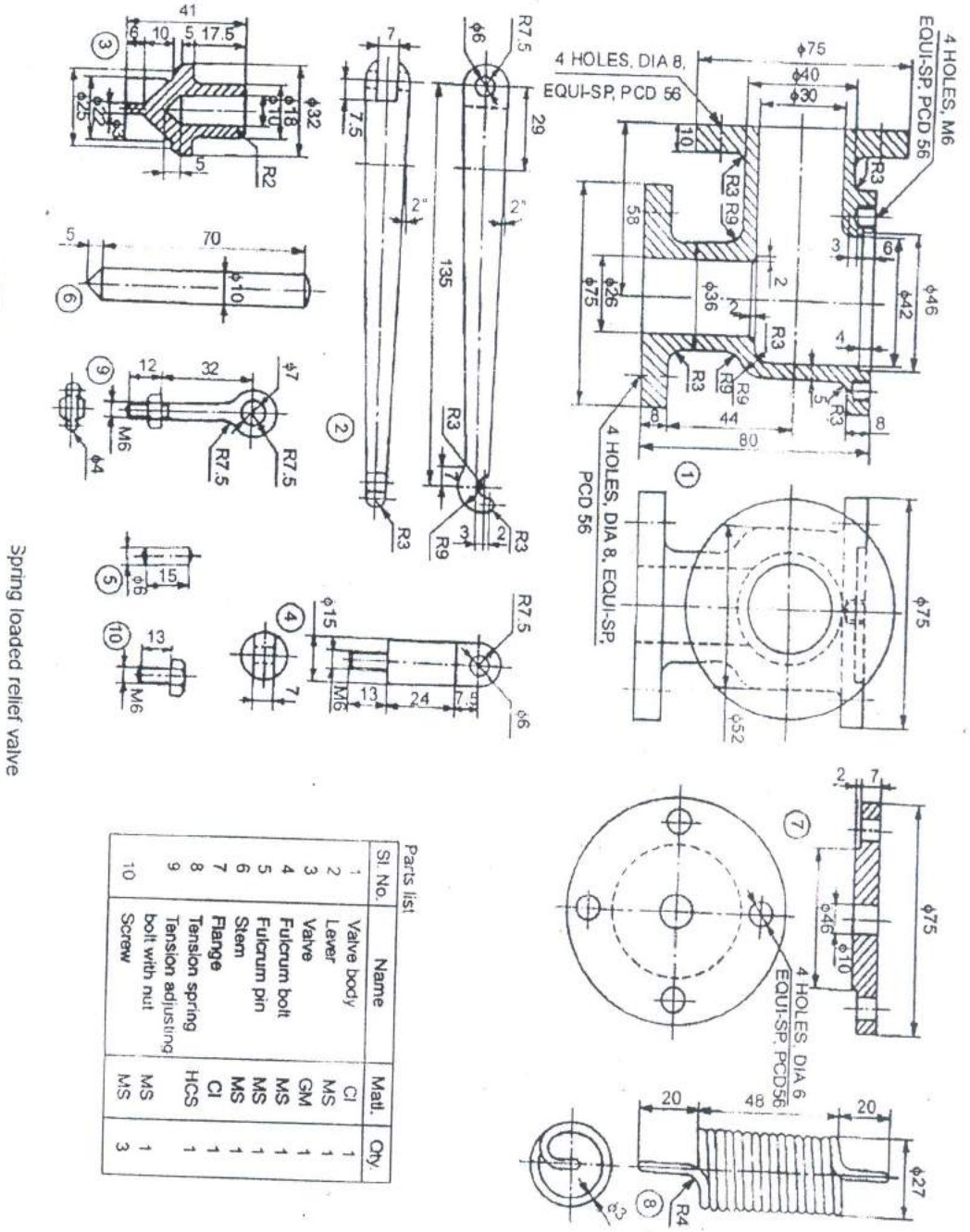


Fig.3



Parts list

Sl. No.	Name	Matl.	Qty.
1	Valve body	CI	1
2	Lever	MS	1
3	Valve	GM	1
4	Fulcrum bolt	MS	1
5	Fulcrum pin	MS	1
6	Stem	MS	1
7	Flange	CI	1
8	Tension spring	HCS	1
9	Tension adjusting bolt with nut	MS	1
10	Screw	MS	3

Fig.4

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Con. 9876–LJ–10382–13. 5

7. Fig.5 shows two views of assembly of Indexing Drill Jig. Draw the following:

1) Rotating pin
   i) Front view — 04
   ii) Side view — 03
2) Locating screw
   i) Front view — 03
   ii) Side view — 02
3) Drill bush
   i) Front view — 03
   ii) Top view — 02
4) Clamp (Front view) — 03

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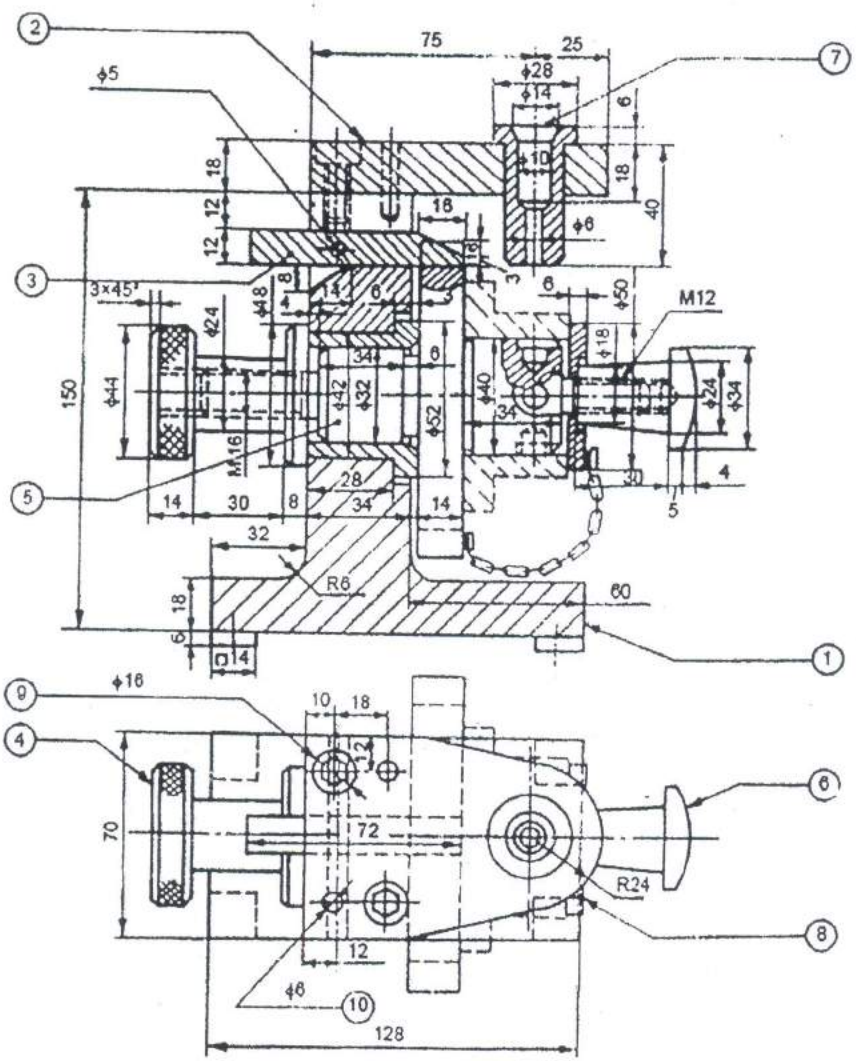

Parts list

Part No.	Name	Mat.	Qty.	Part No.	Name	Mat.	Qty.
1	Jig body	CI	1	6	Clamp	CI	1
2	Bush plate	CI	1	7	Drill bush	HCS	1
3	Indexing lever	MS	1	8	C washer	MS	1
4	Locating screw	MS	1	9	Locating pin	HCS	2
5	Rotating pin	MS	1	10	Dowel pin	HCS	2

Indexing drill jig

Fig.5

SE SEM-III (Rev) Nov-Dec-2013

Sub:- PP-I Date: 10/12/13

MECH/AUTO

45 : 2nd half.13-Avi(au)

Con. 8934-13. GX-12140

(3 Hours) [Total Marks : 80

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **three** questions out of remaining **five** questions.
(3) **Figures** to **right** indicate **full** marks.
(4) Assume suitable **data** if **necessary**.

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Q.1. Write short note on any **four** of following: - (20)

(a) Pattern allowances.

(b) Thermit welding process

(c) Blow moulding process.

(d) Rolling defects.

(e) Important properties of moulding sand.

Q.2. (a) Explain the process of production of seamless tubes by rolling process. (6)

(b) What is weldabiltiy? Discuss various welding defects with their remedies. (8)

(c) With a neat sketch explain the principle of electro slag welding process. (6)

Q.3. (a) Name various methods of powder manufacture techniques in powder metallurgy and explain any one in detail. (8)

(b) Compare TIG and MIG welding process. (8)

(c) Write short note on application of plastics in industries. (4)

Q.4. (a) what is NDT.Explain any two NDT methods in detail. (8)

(a) With a neat sketch explain the working principle of plastic injection moulding process. (6)

(c) List important applications of powder metallurgy technique. (6)

Q 5. (a) with neat sketches explain briefly on "friction welding". (6)

(b) A casting of 50cm × 40cm × 10 cm size solidifies in 20 minutes. Find the solidification time for 40 cm × 30 cm× 5 cm casing under similar conditions. (8)

(c) Differentiate between "soldering" and "brazing" operation. (6)

Q.6. (a) With the help of a neat sketch explain the complete gating system in casting process. (8)

(b) Define the terms "Spread", "Elongation", and "Draft" w.r.t. Rolling process. (6)

(c) Explain vacuum forming process of polymers. (6)

SE SEM-III (REV) NOV-DEC-2013

MECH/AUTO Sub:- SOM Date: 4/12/13 3

25 : 2nd half.13-Avi(at)

Con. 8604-13. **GX-12101**

(3 Hours) **[Total Marks : 80**

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N.B. : (1) Question No. **1** is **compulsory**.
(2) Solve **three** question from remaining **five**.
(3) Assume suitable **data** wherever **necessary**.

Q.1. Solve any Four Questions : 20

A Write a short note on Macaulays Method

B What are the characteristics of bending Moment and What do you mean by point of contraflexure

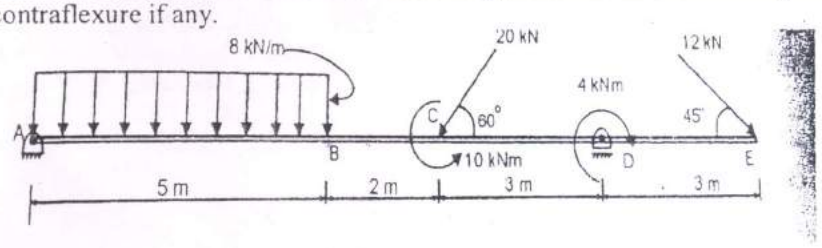
C Prove that $\frac{f_b}{y} = \frac{M}{I} = \frac{E}{R}$

D What is equivalent length of column ? Give the ratio of equivalent length and actual length of column with various end condition

E What is the length of 5 mm diameter aluminium wire so that it can be twisted through one complete revolution without exceeding shear stress of 42 MN/m^2 Modulus of rigidity G= 27 GN/m^2

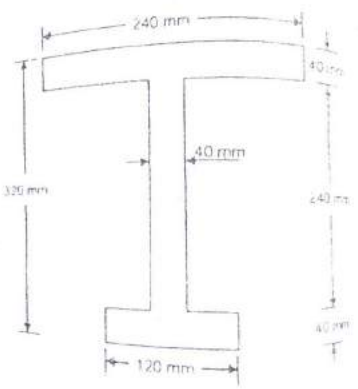
F Derive an expression for elongation due to self weight of bar

Q. 2. A Draw SFD, BMD and AFD for the following beam and also show the point of contraflexure if any. 12



B Find the Euler crushing load for a hollow cylinder cast iron column 200 mm external diameter and 25 mm thick , if it is 6 m long and hinged at both ends. Take E= 1.2 x 10^5 N/mm^2 . Compare the load with the crushing load as given by Rankine formula, taking f_c =550 N/mm^2 and a= 1/1600 08

Q. 3 A A cast iron bracket subjected to bending banding has a C/S of I shape with unequal flanges . If the section is subjected to shear force of 120 KN, Draw shear force distribution diagram over the depth of section 10



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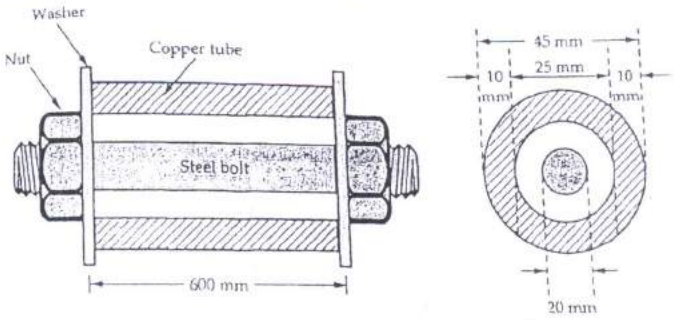
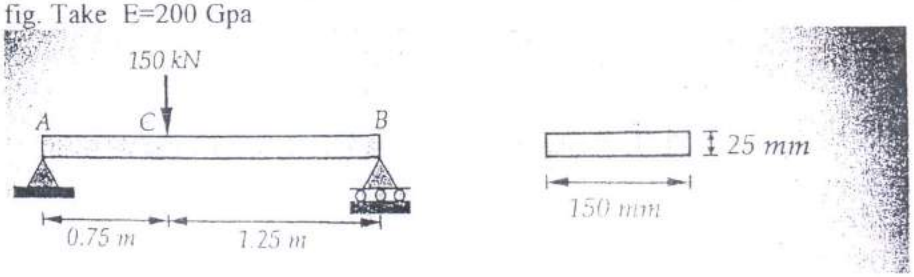
B A Hollow shaft with diameter ratio of 3/8 is required to transmit 500 KW at 100 RPM , the maximum torque being 20 % greater than mean. The maximum shear stress is not exceed 60 N/mm^2 and the twist in the length of 3 m is not exceed 1.4 °. Calculate the minimum diameter required for the shaft . C=84 N/mm^2 10

Q.4 A A wooden beam 250mm x 150 mm has a steel strap 10 mm x 150 mm fixed at the top and the bottom. The beam is subjected to bending moment of 5 KN-m around the horizontal axis . Determine the stress in the steel and wood. Es= 200 GPa, Ew=20 Gpa 10

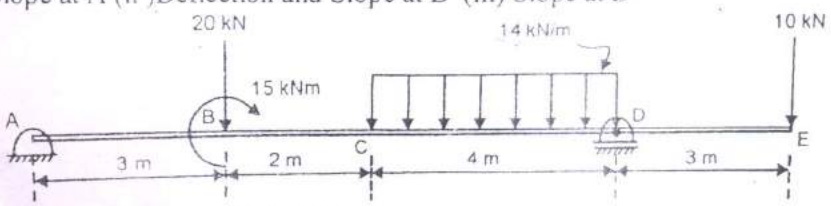
B A Steel bolt of 20 mm diameter passes centrally through a copper tube of internal diameter 25 mm and thickness 10 mm . The tube is 600 mm long and is closed by rigid washer of negligible thickness and fastened by nuts threaded on the bolt. Find the stresses in the bolt & tube when one of the nuts is tightened by the one quarter of the turn relative to other. The pitch of the thread is 2 mm . Take E_s =200 GPa and E_c =100 Gpa 10



Q. 5 A Determine the strain energy of prismatic beam AB for the loading as shown in fig. Take E=200 Gpa 07



B A horizontal beam is loaded and supported as shown in fig . Determine (i)Slope at A (ii)Deflection and Slope at B (iii) Slope at D 13



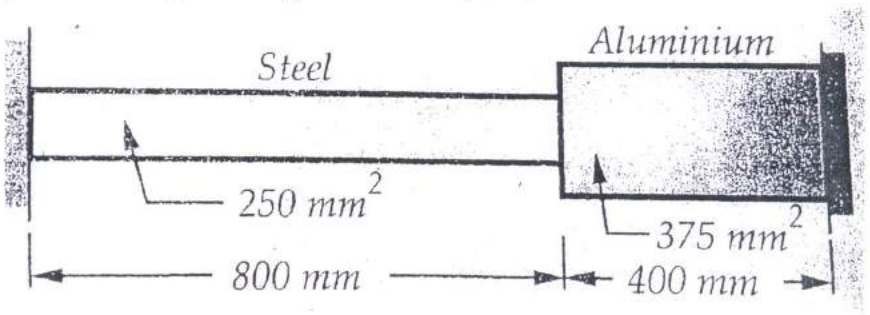
Q.6 A The Composite bar consisting of steel and aluminium components shown in fig Is connected to two grip at a temperature of 60 ° C. Find the stresses in the two rods, when the temperature , falls to 20 ° C 10

(I)If the ends does not yield

(II) If the ends yield by 0.25 mm

Take : $E_S = 2 \times 10^5$ N/mm^2 , $E_A = 0.70 \times 10^5$ N/mm^2.

$\alpha_S = 1.17 \times 10^{-5}$ per °C $\alpha_A = 2.34 \times 10^{-5}$ per °C



B A cylindrical shell 800 mm in diameter and 3 m long is having 10 mm metal thickness. If the shell is subjected to an internal pressure of 2.5 N/mm^2 10

Determine (i) The change in diameter

(ii) The change in length

(iii) The change in volume

Assume the modulus of elasticity and poissions ratio of the material of the shell as 200 KN/mm^2 and 0.25 respectively

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SE SEM-III (Old/OTR) NOV-DEC-2013

MECH/AUTO Sub:- SOM Date: 4/12/13

111 Con-code 5 - JP

Con. 6901–13.

LJ–10313

(3 Hours) **[Total Marks : 100**

N.B. • *Q1 is compulsory. Answer any FOUR from the remaining six questions.*

- *Assume suitable data, wherever required. State the assumptions and justify the same.*
- *Illustrate answers with sketches, wherever required.*
- *Write legibly with blue or black ink pen. Use pencil only to draw diagrams and graphs.*

1. Answer any four :–

a) For a given material, Young's Modulus is 110 GN/m^2 and Shear Modulus is 42 GN/m^2. Find the bulk modulus and lateral contraction of a round bar of 37.5 mm diameter and 2.4 m length, when stretched to 2.5 mm. **[05]**

b) A beam of 15 m long simply supported at 1.25 m from each end carries a concentrated load of 4 kN at each extreme end. Sketch the shear force and bending moment diagrams. **[05]**

c) Derive the torsion formula, $T/J = G\theta/l = \tau/R$. **[05]**

d) A steel specimen 1.5 cm^3 in cross section stretches 0.5 cm gauge length under an axial load of 30 kN. Calculate the strain energy stored in the specimen at this point. If the load at the elastic limit for the specimen is 50 kN, calculate elongation at the elastic limit. **[05]**

e) What do you mean by core of a section? Give the limit of eccentricity for (i) a rectangular section (ii) circular section. **[05]**

f) A symmetrical section 200 mm deep has a moment of inertia 2.26 x 10^{-5} m^4 about the neutral axis. Determine the longest span, over which when simply supported, the beam would carry a uniformly distributed load of 4 kN/m for the entire span, if the stress due to bending does not exceed 125 MN/m^2. **[05]**

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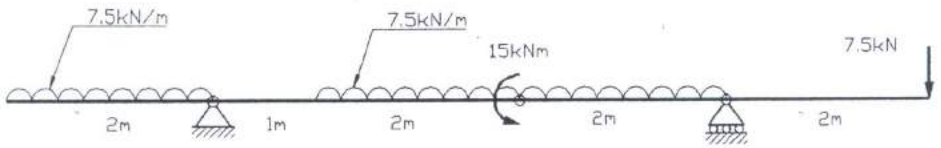
2.a) A concrete column of cross section 400 mm x 400 mm is reinforced with four steel bars of 50 mm diameter placed at each corner. If the column carries a load of 300 kN, determine **[10]**

(i) Load carried by concrete and steel bars

(ii) Compressive stress produced in concrete and steel bars

b) Direct stress of 120 MN/m^2 in tension and 90 MN/m^2 in compression are applied to an elastic material at a certain point on planes right angles to another. If the maximum principal stress is not to exceed 150 MN/m^2 in tension, to what shear stress can the material be subjected? What is then the maximum shear stress in the material? Also, find the other principal stress and its inclination with 120 MN/m^2. **[10]**

3. a) Construct the shear force and bending moment diagram for the beam shown in the figure. **[10]**



b) A simply supported beam of 100 mm wide and 150 mm deep carries a uniformly distributed load over a span of 2 m. If the permissible stress in bending is 28 N/mm^2 and in shear is 2 N/mm^2, calculate maximum load per metre run, which can safely be carried. **[10]**

4. a) A symmetrical I-section has flanges 50 mm x 5(mm and web 109 mm x 3.5 mm. It is subjected to a shearing force of 10 kN. Draw the shear force distribution diagram. **[10]**

b) A beam 4 m long is freely supported at the ends. It carries concentrated loads of 20 kN each at points 1 m from the ends. Calculate the maximum slope and deflection of the beam and slope and deflection under each load. **[10]**

$EI = 13000\ kNm^2$.

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5. a) A copper cylinder 900 mm long 40 mm external diameter and 6 mm wall thickness has both ends closed by rigid blank flanges. It is initially full of oil at atmospheric pressure. Calculate the additional volume of the oil, which must be pumped into it, in order to raise the oil pressure 5 N/mm^2 above atmospheric pressure. For copper, E= 100 GN/m^2 and Poisson ratio= 1/3. Bulk modulus of oil= 2.6 GN/m^2. **[10]**

b) A flitched timber beam consists of two joists 100 mm wide and 300 mm deep with a steel plate 200 mm deep and 15 mm thick placed symmetrically in between and clamped to them. Calculate the total moment of resistance of the section, the allowable stress in the timber is 9 N/mm^2. **[10]**

6. a) While transmitting power of a steam engine, the angle of twist of a rotating shaft was measured as 1.2° over a length of 6 m. The external and internal diameters of the shaft are 250 mm and 170 mm respectively. The rotational speed of the shaft is 250 RPM and shear modulus is 80 GPa. Determine the power transmitted and maximum shear stress developed in it. **[10]**

b) A column 2.5 m long is pin-connected at both ends. It has 50 mm x 100 mm rectangular cross section. Young's Modulus of material is 2 x 10^5 MPa. Determine, **[10]**

(i) Slenderness Ratio

(ii) Euler buckling load

(iii) Safe load, if factor of safety is 2.5

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7. a) A rectangular strut 200 mm wide and 150 mm thick carries a load of 60 kN at an eccentricity of 20 mm in a plane bisecting the thickness. Find the maximum and minimum intensities of stress in the section. **[10]**

b) An unknown weight fall through a height of 10 mm on a collar rigidly attached to the lower end of a vertical bar 5 m long and 600 mm^2 in section. If the maximum extension of the rod is to be 2 mm, what is the corresponding stress and magnitude of the unknown weight? E= 200 GN/m^2. **[10]**

SE SEM-III (REV) NOV-DEC-2013

MECH/AUTO Sub:- Thermo Date:- 29/11/13

G-11-13-DTP28-NK-22

Con. 7882-13. GX-12068

(3 Hours) [Total Marks : 80

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **three** questions out of remaining **five** questions.
(3) Use of steam tabels is permitted.

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1. Explain any **four** of the following :- 20
   (a) State and explain Maxwell relations.
   (b) Claussius inequality.
   (c) Adiabatic flame temperature.
   (d) Second law of thermodynamics.
   (e) Joule's experiment.
   (f) Second law efficiency.

2. (a) Show that the conversion of work into heat is complete and contineous. 4
   (b) Steam flows into a turbine, at a flow rate of 5000 kg/hr. The turbine develops a power of 550 KW. The heat loss from the casing of the turbine and the bearings is negligible. 12
      (i) Find the change in enthalpy across the turbine, if the inlet velocity is negligible and exit velocity is 360 m/s and the change in potential energy is negligible.
      (ii) Find the change in enthalpy across the turbine, if the velocity at entry is 66 m/s and the inlet pipe is 3 m above the exit pipe.
   (c) Show that entropy is a property of system. 4

3. (a) Heat flows through a wall at a rate of 3×10^5 KJ/hr. The temperatures of two faces of the wall are 327°C and 207°C. If the surroundings are at 27°C, What is the loss in available energy? 12
   (b) State and prove carnot theorm. 8

4. (a) A carnot heat engine which operates between temperature levels of 927°C and 33°C rejects 30 KJ to the low temperature sink. The heat pump receives 270 KJ of heat from a low temperature reservoir and rejects it to the surroundings at 33°C. Determine the temperature in °C of the low temperature for the heat pump. 12
   (b) Derive an expression for an air-standard efficiency for otto cycle. 8

5. (a) Steam at 500 kPa having a quality of 0.9 expands adiabatically and reversibly to a final pressure of 100 kPa. Determine its final condition. 10

(b) The ultimate analysis of a solid fuel is as follows :- 10

C = 78%, O_2 = 3%, H_2 = 3%, S = 1%, moisture = 5% and ash content = 10%

Calculate the mass of air supplied. Also calculate individual and total mass of products of combustion per kg of fuel if 30% of excess air is supplied for combustion.

6. (a) In an air-standard dual cycle, the pressure and temperature are 0.1 mPa and 27°C. The compression ratio is 18. The pressure ratio for the constant volume part of heating process is 1.5 and the volume ratio for the constant pressure part of heating is 1.2. Determine :- 12

(i) thermal efficiency.

(ii) mean effective pressure in M Pa.

(b) State the Clausius clapeyron equation. 4

(c) Draw a simple schematic of thermal plant with one reheater. Also represent it on T-S-diagram. 4

SE SEM-III (old) Nov - Dec-2013

Sub:- Thermo Date:- 29/11/13

MECH/AUTO

80 Con-code 3 - JP

Con. 6491–13. **LJ–10277**

(3 Hours) **[Total Marks : 100**

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N.B. 1) Question No. 1 is compulsory.

2) Attempt any four questions out of reaming six questions.

3) Assume suitable data, if required.

4) Use of steam table, moillier diagram are permitted.

Q. 1. Answer any five of the following:- **20**

a) Differentiate between point function and path function

b) Show that internal energy is property of system

c) What are assumptions of air standard cycle?

d) State the zeroth law of thermodynamics. What is its significance?

e) What do you mean by Available and Unavailable energy?

f) Difference between heat engine, refrigerator, heat pump

g) What are the limitations of first law of thermodynamics?

Q.2. a) Develop the following expression for the heat transfer from a mass of gas undergoing reversible expansion process obeying the polytrophic law $PV^n = C$

$Q_{1-2} = \frac{\gamma - \eta}{\gamma - 1}$ X Polytropic work done **6**

b) What is Joule –Thomson coefficient? Explain inversion point and inversion curve. **4**

c) A quantity of gas occupies a volume of 0.28 m^3 at a pressure of 1.03 bar and temperature of 21°C.The gas is compressed isothermally to a pressure of 5.15 bar and than expanded adiabatically to its initial volume. Determine for this quantity of gas. a) Heat received or rejected during compression in KJ. b) Change of internal energy of gas during expansion in KJ. c) The mass of gas in kg.Take C_P= 0.921 KJ/kg-K C_V = 0.5678 KJ/kg-K . Draw P-V diagram. **10**

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Q.3. a) State the second law of thermodynamics, and establish the equivalence between them. 10

c) A reversible heat engine operates between two reservoirs at temperatures of 875 K and 310 K the engine drives the reversible refrigerator which operates between the reservoirs at temperature of 310 K and 255 K. The heat transfer to the engine is 2000 KJ and the net work output of the combined engine and refrigerator plant is 350 KJ. Make calculation for cooling effect. **10**

Q.4. a) Derive the Steady flow energy equation. Apply it to compressor. **8**

b) In a steady flow process, the fluid flows through a machine at the rate of 15 kg/ min. Between the entrance and exit of machine, the inlet velocity 5 m/s, pressure 100 KPa and specific volume 0.45 m^3/kg and outlet velocity 8 m/s, 700 KPa pressure , 0.125m^3/kg .The working fluid leaves the machine with internal energy 160 kJ/kg greater than that at entrance and during the process 7200 kJ/min of heat is lost to the surrounding . Assuming entrance and exit pipe to be at same level, calculate the shaft work and the ratio of inlet and outlet pipe diameter. **12**

Q.5. a) Define a) Wet steam b) Superheated steam c) Dryness fraction d) Saturation temperature. **8**

b) In a thermal power plant operating on an ideal Rankin cycle, superheated steam produced at 1.5 MPa and 300°C is feed to a turbine where it expands to the condenser pressure of 80 KPa. The saturated liquid coming out of the condenser is pumped back to the boiler by a feed pump. Assuming ideal Processes, determine a) The condition of steam after isentropic expansion, b) Rankine cycle efficiency, c) The mean effective pressure, d) The ideal steam consumption per kW hour e) The actual steam consumption per kW hour. Take relative efficiency = 60% and neglect pump work. **12**

Q 6. a) Derive an expression for the air standard efficiency and mean effective pressure of an Otto cycle. **10**

b) In an air standard diesel cycle air a 0.1 MPa and 300 K is compressed adiabatically until the pressure rise to 5 MPa . If 700 kJ/kg of energy in the form of heat is supplied at constant pressure, determine the compression ratio, cut off ratio,thermal efficiency and Mean effective pressure. **10**

Q.7. a) Define 1) Mach No., 2) Stagnation temperature ,3) Stagnation Pressure 4) Sonic flow. Explain the effect of variation in back pressure on C-D nozzle performance. **10**

b) A supersonic nozzle is to be designed for air flow with Mach number 3 at the exit section which is 250 mm in diameter. The pressure and temperature of air at the nozzle exit are 8.5 kN/m^2 and 215 K. Make calculation for a) reservoir pressure and temperature b) throat area. **10**

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SE sem-III (old) NOV-Dec-13

MECH/AUTO Sub:-AM-III Date:25/11/13

V-A4-H-Ex-13-E-48

Con. 6481-13. **LJ-10243**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of the remaining **six** questions.
(3) **Figures** to the **right** indicate **full** marks.

1. (a) Find the constant 'P' if $f(z) = r^2\cos(2\theta) + i\, r^2\sin(p\theta)$ is analytic. 5
   (b) Find the image of the circle $|z| = 2$ un der the transfromation $w = z + 3 + 2i$. 5
   (c) Find the laplace transform of $\cos^5(f)$. 5
   (d) If A is nonsingular matrix of order 'n' then show that $\text{adj}\cdot\text{adj}(A) = |A|^{(n-2)} A$. 5

2. (a) Find the eigen values and eigen vectors corresponding to the following matrix A where 6

$$A = \begin{bmatrix} 10 & -2 & -5 \\ -2 & 2 & 3 \\ -5 & 3 & 5 \end{bmatrix}$$

   (b) Find an analytic function f(z) whose imaginary part is $\dfrac{\sin(2x)}{\cosh(2y) + \cos(2x)}$. 6
   (c) Find the laplace transfrom of the following :— 8

   (i) $\dfrac{e^{-t}\sin(t)}{t}$ (ii) $\displaystyle\int_0^t u^2 \sin(u)\, du.$

3. (a) Test for consistency and solve :— 6

$$5x_1 + 3x_2 + 7x_3 = 4$$
$$7x_1 + 2x_2 + 10x_3 = 5$$
$$3x_1 + 26x_2 + 2x_3 = 9$$

   (b) Find the bilinear transformation which maps the points $-1, 1, \infty$ onto the points $-1, -1, i$. 6
   (c) Find the inverse laplace transform of the following :— 8

   (i) $\log\left(\dfrac{s^2 + a^2}{\sqrt{s+b}}\right)$ (ii) $\dfrac{(s+1)\, e^{-s}}{(s^2 + s + 1)}$

4. (a) Find non-singular matrices P and Q such that $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 3 \\ 3 & 0 & 5 & -10 \end{bmatrix}$ is reduced to normal form. Also find its rank. 6

   (b) Evaluate $\displaystyle\int_{-\infty}^{\infty} \frac{dx}{(x^2 + 1)^3}$. 6

   (c) (i) Find $L^{-1}\left\{\dfrac{3s + 1}{(s+1)(s^2 + 2)}\right\}$ 4

   (ii) Evaluate $\displaystyle\int_0^{\infty} e^{\left(-\sqrt{2}\right)t} \sin(t)\sinh(f)dt.$ 4

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5. (a) Using laplace transform solve the following $(P^2 + 2D + 5)\, y = e^{-t} \sin(t)$ when $y(0) = 0$ and $y'(0) = 1$. 6

(b) Find the orthogonal trajectory of the family of curves $e^{-x}(x \sin(y) - y \cos(y) = C$. 6

(c) (i) . Evaluate $\int_C \frac{dz}{z^3 (z+4)}$ where 'C' $|z| = 2$. 4

(ii) Evaluate $\int_C \frac{z-1}{(z+1)^2 (z-2)}\, dz$ where 'C' encloses both poles of $f(z)$. 4

6. (a) Examine whether the vector $x_1 = (1, 2, 4)$ $x_2 = (2, -1, 3)$ and $x_3 = (0, 1, 2)$ are linearly independent. 6

(b) Find the image of the rectangular hyporbola $x^2 - y^2 = 1$ under the transformation $w = 1/z$. 6

(c) Expand $f(z) = \frac{1}{(z-1)(z-2)}$ in the regions : 8

(i) $1 < |z - 1| < 1$ (ii) $1 < |z - 3| < 2$ (iii) $|z| < 1$

7. (a) Evaluate $\int_0^{2\pi} \frac{d\theta}{13 + 5\cos(\theta)}$. 6

(b) If $A = \begin{bmatrix} 2 & 3 \\ -3 & -4 \end{bmatrix}$ Find A^{50}. 6

(c) Verify Cayley-Hamilton theorem for the matrix A and there find A^{-1} and A^4 where : 8

$$A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$$

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