THEORY OF MACHINE (MET - 401)

Chapter No. - 1 (Module - I)

Name of the Chapter:- Simple Mechanisms

Question Booklet

Group – A

1	Define kinematic link. Mention its types.	[2011, 2013, 2015-S]
2	Define kinematic pair.	[2011]
3	Define lower pair.	[2011, 2012]
4	What is the difference between lower pair and higher pair?	[2012(S)]
5	Define kinematic chain.	[2012(S)]
6	Define machine and mechanism.	[2015-S]
7	What is the function of cam and follower?	[2012(S)]
8	Define higher pair.	
9	What is the relation between the no. of links and no. of binary joints for a kinematic chain?	
10	Define Inversion of a mechanism.	
11	What is the difference between a rigid and resistant body?	
12	What do you mean by a structure?	
13	What is constrained motion?	
14	Why cams are used?	
15	The lead screw of a lathe with the nut forms which pair?	
16	A ball and socket joint forms a which pair?	
17	What do you mean by a coupler in four bar mechanism?	

Group – B

1	Explain the sliding pair, turning pair, rolling pair and screw pair with figure.	[2013]
2	With neat sketh explain crank and sloted lever quick return mechanism.	[2012(S)]
3	What is inversions? Explain the inversion in crank and connecting rod mechanism.	[2011]
4	Explain four bar mechanism with their inversion	[2014]
5	Write notes on complete and incomplete constrained motion in lower and higher pairs. Illustrat the answer with neat sketch.	
6	Write short notes on cam and follower.	[2014]
7	What is inversion of mechanism ?	[2015-S]
8	In a crank and slotted lever mechanism (quick return), the distance between the fixed centres 180 mm and the driving crank is 90 mm long. Determine the ratio of the time taken on the cutti and return strokes.	

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15. A shaft has a number of collars integral with it. The external diameters of the collars is 400mm and the shaft diameter is 250m. If the intensity of pressure is 0.35N/mm2(uniform) and the coefficient of friction is 0.05 estimate i.) power absorbed when the shaft runs at 105 rpm carrying a load of 150 KN and (ii) Number of collars required. **Ans.: 13.638 KW & 06** [2012(S)]

16. A conical pivot bearing 150 mm dia has a cone angle of 120°. If the shaft supports an axial load of 20 KN and the co-efficient of friction is 0.03. Find the power lost in friction when the shaft rotates at 200rpm assuming (i) Uniform pressure, (ii) Uniform wear. **Ans.: 725.49 W & 544.13 W** [2011,2012(S)]

17. A plain collar type thrust bearing having inner and outer diameters of 200 mm and 450 mm is subjected to an axial thrust of 40 kN. Assuming coefficient of friction between the thrust surfaces as 0.025, find the power absorbed in overcoming friction at a speed of 120 r.p.m. The rate of wear is considered to be proportional to the pressure and rubbing speed. **Ans. P=4.1KW**

18. A square threaded screw jack having screw diameter 50mm and pitch 12 mm. If the coefficient of friction is 0.2, what force will be applied at the end of 1m lever to raise a load of 5 tonnes by this screw jack? Also calculate the efficiency of the screw jack.
Ans. F=3433.75N, Efficiency = 27% [2014]

19. A multiple disc clutch has five plates having four pairs of active friction surfaces. If the intensify of pres sure is not to exceed 0.15 N/mm² find the power transmitted at 400 rpm. The outer and inner radius of friction surface are 120 mm & 60 mm respectively. Assume uniform wear and co-efficient of friction to be 0.3. **Ans. 15.35KW** [2014]

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Chapter No-3 (Module - III)
Name of the Chapter:- Power Tranmission
Question Booklet

Group – A

1. Differentiate between total tension and centrifugal tension. 2010(s)
2. Define velocity ratio and speed ratio. 2010(s)
3. Define creep and slip. 2010(s)
4. What is crowning of pulley 2013(s)
5. Define module [2011,2012]
6. Define circular pitch in toothed gear.
7. Define diameteral pitch, [2010(s), 2011,2012]
8. Define velocity ratio of a simple gear drive. 2010(s), 2011
9. Define velocity ratio of compound gear train. 2012(S
10. What is reverted gear train?
11. Give an example of reverted gear train.
12. What are the different types of drives used for power transmission?
13. What is the minimum nos of teeth required for a pinion & why.
14. How power transmission is affected by centrifugal tension?
15. State expression for length of open belt.
16. State expression for length of cross belt.
17. State expression for ratio of tension in belt drive.
18. What is the difference between a brake and a dynamometer ?

Group-B

Part-1 : (Solved)

1. Write various types of belt drive. 2013(s)
2. Derive ratio of tension in flat belt drive. [2015-S]
3. Explain working principle of fast and loose pulley. 2012(S)
4. What do you understand by "gear train" . Discuss various types of gear trains. 2011, 2012
5. Explain why crowning of pulley is done? [2014]
6. Derive an expression for velocity ratio in a belt drive.
7. Explain use of idler pulley / jockey pulley.
8. Derive the formula for length of belt for open flat belt drive. [2011]
9. An engine shaft running at 120 r.p.m is required to drive a machine shaft by means of a belt. The pully on the engine shaft is of 2 m diameter and that of the machine shaft is 1 m diameter. If the belt thickness is 5 mm; determine the speed of the machine shaft, when 1, there is no slip; and 2 there is a slip of 3%. **Ans. N_1 = 239.4rpm, N_2 = 232.3rpm** [RSK, Q-1]
10. A pulley is driven by a flat belft running at a speed of 600 m/min. The coefficient of friction between the pulley and the belt is 0.3 and the angle of lap is 160°. If the maximum tension in the belt is 700 N; find the power transmitted by a belt. **Ans. P=3.983KW** [RSK, Q-3]
11. An open belt 100 mm wide connects two pulleys mounted on parallel shafts with their centres 2.4m apart. The diameter of the larger pulley is 450 mm and that of the smaller pulley 300mm. The

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coefficient of friction between the belt and the pulley is 0.3 and the maximum stress in the belt is limited to 14 N/mm width. If the larger pulley rotates at 120 rpm, find the maximum power that can be transmitted. **Ans. P=2.39KW**

12. A flat belt is requied to transmit 35 kW from a pulley of 1.5 m effective diameter running at 300 r.p.m. The angle of contact is spread over 11/24 of the circumference and the coefficient of friction between belt and pulley surface is 0.3. Determine, taking centrifugal tension into account, width of the belt required. It is given that the belt thickness is 9.5 mm, density of its material is 1.1 Mg/m^3 and the related permissible working stress is 2.5 MPa. [RSK, Q-7]

    Ans. L=143mm

13. A flat belt, 8 mm thick and 100 mm wide transmits power between two pulleys, running at 1600 m/ min. The mass of the belt is 0.9 kg/m length. The angle of lap in the smaller pulley is 165° and the coefficient of friction between the belt and pulley is 0.3. If the masximum permissible stress in the belt is 2 MN/m^2, find : 1. maximum power transmitted; and 2. initial tension in the belt.

    Ans. P=14.83KW, T=1002N [RSK, Q-11]

14. A power of 15W is to be transmitted by a pulley of 90 cm diameter rotating at 180 rpm. The angle of lap is 160 degree and the coefficient of friction is 0.25. If the safe pull per cm of width of belt is 150 N, Calculate the width of the belt. **Ans. b=0.023cm** [2014]

15. Find the width of belt necessary to transmit 7.5 KW to a pulley 300 mm diameter, if the pulley makes 1600 rpm. And the coeff. Of friction between belt & the pulley is 0.22 Assume angle of contact is 210° & maximum tension is not to exceed to 8 N/mm width. **Ans.: 320mm**

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Chapter – 7 (Module - III)

Turbines

Group-A

1. Define turbine. [2011, 2012(S)]
2. Define impulse turbine [2013(s)]
3. What do you mean by gross head of turbine? [S]
4. What do you mean by net head of turbine? [S]
5. What do you mean by reaction turbine [2013(s)]
6. What is the difference between axial flow & radial flow reaction turbine [2014(s)]
7. Write the expression of hydraulic efficiency of a Francis turbine runner. 2012(N)
8. Define hydraulic efficiency of a turbine. [2010(s), 2011]
9. Differentiate between Impulse & reaction turbine. [2014-S]
10. What is the function of surge tank [2014-S]
11. Classify turbine in terms of head of water available. [2015 -S]

Group-B

1. Classify the hydraulic turbines with examples.
2. Describe the construction & working of a francis turbine ? [2014(S)]
3. Derive the condition of transmission of maximum hydraulic efficiency of an pelton turbine runner. [2012]
4. Draw the velocity triangle of single Bucket of a pelton wheel and find the expression for workdone / sec. [2015 (S) BP]
5. Draw the layout of a hydro-electric powerplant and mention its features. [2015 (S)]
6. A pelton wheel has to develop 5000 kW under a net head of 300 m while running at a speed of 500 rpm. Calculate the following:
   i) Quantity of water supplied to the turbine. **Ans. : 3.4 m^3 / sec**
   ii) Diameter of pitch circle of wheel. **Ans.: 1.3 m**
   iii) Nos. of jets. **Ans.: 4**

   Assume the following data : $C_v = 0.97, K_u = 0.46, \frac{d}{D} = \frac{1}{10}, \eta_0 = 80\%$ [2012S(N)]
7. A pelton wheel having a mean bucket diameter of 1m is running at 1000 rpm. The net head on the Pelton wheel is 700m. If the side clearance angle is 15° and discharge through the nozzle is 0.1 m^3/s. Find (i) Power available at the nozzle, (ii) Hydraulic efficiency of the turbine. **Ans.: 686.7KW, 97.18%** [2011]
8. A Pelton wheel has a mean bucket speed of 25m/sec witha jet of water flowing at a rate of 1.2 m^3/ sec under a head of 250m. The buckets deflects through an angle of 170°. the hydraulic efficiency. [2016s]

   Ans. 96.1%

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Chapter No-4 (Module - I)
Name of the Chapter:- Governors and Flywheels
Question Booklet

Group – A

1. Write down the classification of governor. [2011, 2013]
2. What is the function of governor? [2010(s)]
3. Draw the watt governor diagram. [2010(s), 2011,2012]
4. What is meant by 'sensitiveness' of Governor? [2011, 2012,2014]
5. Define Isochronism. [2012]
6. What is the function of flywheel? [2011, 2012]
7. Define coefficient of fluctuation of speed in case of flywheel.
8. Define 'sleeve' lift of a governor.
9. What is "coefficient of insensitiveness" of governor?
10. Define stability of a Governor.
11. Define hunting.
12. Define fluctuation of energy.
13. Differentiate between governor and flywheel.

Group-B

1. Explain the woring of a porter governor. [2015]
2. Explain the working principle of Hart Nell governor with neat sketch. [2013(s)]
3. A porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ba has a mass of 5 kg and the mass of the central load on the sleeve is 15 kg. The radius of rotatic of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximu speed. Find the minimum and maximum speeds and range of speed of the governor.
   Ans. N_1 = 133.76rpm, N_2 = 154.45rpm, N=20.644rpm
4. The of mass of flywheel of an engine is 6.5 tonnes and the radius of gyration is 1.8 meters. It found from the turning moment diagram that te fluctuation of energy is 56 KN-m. If the mean spee of the engine is 120 rpm, find the maximum and minimum speeds.
   Ans. N_1=120.99rpm, N_2=118.44rpm
5. Write short note on working of watt Governor. [2011, 2012]
6. Explain stability, sensitiveness and isochronism of a Governor 2012(S
7. A porter governor has two balls each of mass 3 kg and a central load of mass 15 kg. the arms a all 200 mm long, pivoted on the axis. If the maximum and minimum ratio of rotation of the balls 160 mm and 120 mm respectively, find the range of speed. **Ans.: 28.34 rpm** [2011, 2012]

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8. A horizontal cross compound steam engine develops 300 KW at 60 rpm. The co-efficient of fluctuation of energy as found from the turning moment diagram is to be 0.1 and fluctuation of speed is to be kept within ± 0.5 % of the mean speed. Find the weight of the fly wheel required if the radius of gyration is 2 meters. **Ans. : 5628.95 KG** [2012(S)]

9. The flywheel of a steam engine has a radius of gyration of 1m and mass 2500kg. the starting torque of the steam engine is 1500 N-M and may be assumed constant. Determine: (i) the angular acceleration of the flywheel and (ii) the KE. energy of the flywheel after 10 seconds from the start. **Ans.: 0.6 rad/sec², 45KJ**

10. In a turning moment diagram, the areas above and below the mean torque line taken in order are 4400, 1150, 1300 and 4550mm² respectively. The scales of the turning moment diagram are : Turning moment, 1 mm = 100 N-m; Crank angle, 1mm = 1°
Find the mass of the flywheel required to keep the speed between 297 and 303 r.p.m, if the radius of gyration is 0.525m. **Ans. m=417kg** [RSK Q.3]

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Chapter No-5 (Module - IV)
Name of the Chapter:- Balancing of Machine Parts
Question Booklet

Group – A

[2011]

1 Define static and dynamic Balancing.

2 Why balancing is required for rotating and reciprocating parts?

3 What is partial balancing?

Group-B

1 Differentiate between static and dynamic balancing with neat diagram. [2011, 2012]

2 Explain method of balancing of a single rotating mas by two masses revolving in different planes

[2012]

3 Explain the principle of balancing of reciprocating masses. [2014]

4 State the cause and effect of unbalance.

5 Explain static balancing of rotating parts

6 Explain with neat diagram the static and dynamic balancing. [2010(s)]

7 The four masses, m_1, m_2, m_3 & m_4 are respectively, 200 kg, 300 kg, 240 kg and 260 kg. th corresponding radii of rotation are 20 cm, 15 cm, 25 cm and 30 cm and the angles are 45°, 75°, ar 135°. Find the position and magnitude of the balance mass required if the radius of rotation is 20 cr

Ans. 116kg, α=201.48°

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Chapter No-6 (Module - II)
Name of the Chapter:-Vibration in Machine Parts
Question Booklet

Group – A

1 Define amplitude. [2011, 2012, 2013(s)]

2 Define time period [2011, 2013(s)]

3 Define damped vibration. [2014(s)]

4 Define free/Natural vibration.

5 Define forced vibration. .

6 Define longitudinal vibration. .

7 Define and sketch torsional vibration. .

8 What is the relation between 'time period' and 'frequency' in vibration?

Group-B

1 State the causes and remedies of vibration. [2014(s)]

2 What is meant by "free vibration"? Explain the types of free vibration. 2010(s)]

3 Explain basic concept of longitudinal and Trans verse vibration with sketch.

4 Derive an expression for the frequency of free torsional vibrations for a shaft fixed at one end and carrying a load on the free end.

5 A shaft of 100mm diameter and 1 meter long is fixed at one end and other end carries a flywheel of mass 1 tonne. Taking Yong's modulus for the shaft material as 200 GN/m^2, find the natural frequency of longitudinal and transverse vibrations. [2016s]

6 Explain the terms under damping, critical damping and over damping. [2016s]

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MANUFACTURING TECHNOLOGY (MET-402)

Chapter No. - 1 (Module - II)

Name of the Chapter:- Tool Materials

Questions Booklet

Group –A

1 What is the composition of HSS? [2010(S)/2015]

2 Name four important tool material with their composition. [2014(W)]

3 State composition of 18-4-1 HSS tool. [2011 (S)]

4 State properties of ceramics and CBN as tool materials.

5 State composition of high speed steel and satellites.

6 State the composition of HSS and cemented carbides. Which is better when toughness is desired?

7. Difine Abrasives. [2015]

Group-B

1 State the properties of high speed steel and write the composition of different types of high speed steel.

2 Write down the various mechanical properties of cutting tool material. [2013s]

3 State the composition and two important properties of satellites and CBN as cutting tool material

4 Write down various tool materials composition with their physical properties and uses. [2013s]

5 Name different type of cutting tool materials in order of strength, toughness etc and describe in brief about them. [2013S]

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Chapter No-2 (Module - I)
Name of the Chapter:- Cutting Tools
Questions Booklet

Group –A

1 Name two single point cutting tools and two multipoint cutting tools. [2010(

2 Define cutting speed and feed.

3 State the purpose of providing rack angle and clearance angle.

4 What do you mean by a multipoint cuttings tool?

5 Write the name of 4 cutting fluids.

6 State the importance of rake angles in a single point cutting tool.

7 Which cutting fluid is used for finishing aluminum alloys?

8 What is the effect of cutting fluid on tool life?

9 Name four cutting tools materials.

10 Define tool life. [201

Group-B

1 Explain cutting action of a chisel and hack saw blade. [2010-S]

2 State the purpose of using cutting fluids / Coolants / Lubricants. [2015S

3 What are the good qualities of a cutting fluid?

4 Why do you provide various tool angles on a cutting tool?

5 Explain tool geometry of a single point cutting tool with neat sketch. [2010(

6 Draw three view of single point cutting tool [2014(

7 What are the factors that affect tool life ? Brifly describe their influence [201

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Chapter No-3 (Module - I)

Name of the Chapter:- Lathe Machine

Questions Booklet

Group - A

1. Explain with neat sketch, any one method of taper turning [2014 w]
2. Mention the specification of a lathe [2012(S)]
3. Define S.S & S.C. lathe? [2010(s)]
4. Define multiple tool holder [2011]
5. Differentiate between capstan & turret lathe. [2012(s)]
6. What are different methods of taper turning?
7. Name four components of lathe machine. [2010(s)]
8. Why lead screw in a lathe is square threaded?
9. Write any four application of lathe [2012(S)]
10. What is feed of cut ?
11. What is the use of turret lathe?
12. Differentiate between capstan & engine lathe.
13. Define grooving

Group – B

1. Write short notes on taper turning. [2012(n),2010(s),2011]
2. Enlist different parts of a lathe carriage and briefly explain respective functions.
3. What are the advantages of Capstan & Turret lathe over engine lathe. [2010(s), 2013(s)]
4. Write short notes on Tool layout of capstan & turret lathe. [2010(s)]
5. What is capstan and Turret lathe any name the tool holding devices uses in captain & turret lathe
6. Give comparison between SC Lathe & S.S. Lathe
7. List the different operating on lathe?
8. What is the material for lathe bed and why
9. Explain the indexing arrangements for turret head with neat sketch [2012(o)]
10. Describe the different components of lathe & their functions [2010(s)]
11. State the advantages and disadvantage of capstan lathe over S.S, and S.C. lathe.
12. Draw the tooling layout for preparation of a hexagonal headed bolt. [2015]
13. Explain tailstock set over method after taper turning. [2015BP]
14. Describe in brief various prts of capstan and turret lathes. [2015s]
15. Explain thread cutting mechanism normally carried out on a lathe.

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Chapter No- 4 (Module - II)
Name of the Chapter:-Shaper
Questions Booklet

Group – A

1. State the function of dividing head in a shaper machine [2010(s),2014
2. Name different quick return mechanism used in shaper. [2010(s)
3. Define & draw the quick return mechanism. [2011
4. Write down 4 different parts of shaper machine. [2016s
5. Define shaper.
6. How the size of shaper is generally specified? [2015s
7. Define speed, feed & depth of cut in a shaper ?

Group-B

1. Explain with neat sketch the bar feeding mechanism [2009(s)
2. Explain the working of the tool head of a shaper.
3. What are the common work holding devices used on a shaper?
4. Briefly explain with neat diagram parts of a shaper & its working principle. [2011
5. Explain the quick return mechanism of a shaper through neat sketch. [2014 2013(s)
6. Explain with a neat sketch the crank & slotted lever quick return mechanism of a shaper. [2010(s)
7. Sketch and describe the working of automatic table feed mechanism of a shaper. [2016(s)

Chapter No-5 (Module - II)
Name of the Chapter:-Planning Machine
Questions Booklet

Group.-A

1 Differentiate between planer & shaper, [2010(s
2 What is a planer?
3 How do you classify planers?
4. In which way vertical shaper is different from a slotter ? [2016(s

Group-B

1 What is a planner and describe its working principle
2 How does a 'planer' differ from a shaper? [2016
3 Enlist different parts of planning machine.
4 Describe the function of planer with a neat sketch.
5 Explain table drive mechanism of a planning machine [2014, 2016

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Chapter No-6 (Module - III)
Name of the Chapter:- Milling Machine
Questions Booklet

Group.-A

1 Name different types of milling [2014]

2 What is indexing? [2011]

3 What is feed and how it is expressed on milling M/C

4 Name four work holding devices used on milling M/C

5 Name four types of milling machine?

6 What is universal milling machine

7. What is deviding head. [2015]

8 What operations canbe carried out by a milling m/c ? [2016s]

Group-B

1. What is the difference between up milling and down milling? [2012(o)]

2. What is compound indexing? Find the differential indexing method for '73' divisions. [2010(s), 2010(s), 2012(s)]

3. What are the cutters used for milling key ways. T slots and dovetail grooves? [2013(s)]

4. Briefly explain the differential indexing. [2010(s)]

5. Explain work holding attachment in milling m/c [2011]

6. Compare between plain and universal milling machine. [2016s]

7. Name and describe the Principal parts of a milling machine.

8. Describe the working of a universal dividing head with neat sketch. [2015 (S)]

9. With a neat sketch explain the construction and working of universal milling machine. [2013(s)]

10. Describe the function of simple deviding head and universal dividing head. [2011, 2013(s)]

11. Describe the different numerical indexing procedure in milling M/C

12. Explain various work holding attachments used in milling machine ? [2015BP, 2016s]

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Chapter No-7 (Module - III)
Name of the Chapter:-Slotter
Questions Booklet

Group.-A

1. What is precession slotter?
2. What is the use of slotter?
3. What is a puncher Slotter?
4. Write down 4 parts of slotter?
5. Differentiate between a slotter & a vertical shaper. [2009(s), 2013(s), 20

Group-B

1. Describe the main parts of a slotting machine. [2
2. What are the operations performed by the slotting M/C?
3. How is a slotting machine specified?
4. Briefly explains the construction and working principle of a slotter?
5. How do you classify the slotting machines?
6. What are the tools used in slotter machine. [20

Chapter No-8 (Module - III)
Name of the Chapter:-Grinding
Questions Booklet

Group.-A

1 Define grinding & Grinding wheel. [2014,20
2 What do you mean by grit, grade, bond, structure in case of abrasive wheel ? [2010, 2015
3 What are different abrasives used in making a grinding wheel?
4 What is Cylindrical grinder.
5 What is surface grinding M/C and classify the surface grinding M/C?
6 What is centre less grinding?
7 Define abrasive.
8 Write different types of bonds used in making of a grinding wheel. [20 [201

Group-B

1 State criteria for selection of grinding wheels.
2 Describe the function of centre less grinder with a neat sketch. [2014, 2010
3 Explain the specification of grinding wheel. [2011,. 201
4 What are the different types of bonds used on the manufacture of abrasive wheels? [2010
5 Explain the working of surface grinder
6 Explain manufacturing of grinding wheels. [201
7 Explain the working of cylindrical grinding m/c with diagram. [201
8 Describe various grinding operation. [20
[201

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Chapter No-9 (Module - IV)

Name of the Chapter:- Drilling, Boring, Broaching

Questions Booklet

Group.-A

1	What is drilling?	[2011]
2	Define boring.	[2014 ,2011]
3	Define broaching.	[2013(s)][2014 w]
4	Specify different types of drilling machines.	[2015s]

Group-B

1	Explain the drawing of radial drilling machine.	[2014]
2	Differentiate bench drilling machine and pillar drilling machine.	[2010(s)]
3	Give a comparison between piller drilling M/C, and radial drilling M/C.	[, 2011]
4	Explain working of pillar drilling machine with neat sketch?	
5	Explain the advantages of different types of broaching.	
6	How do you classify different types of drills?	
7	Differentiate between boring and milling	
8	Explain different types of broaching operations.	
9	With neat sketch describe the parts & function of a radial drilling machine.	[2013(s)]
10	Draw a neat sketch of a bench drilling machine and explain different parts.	[2010(s)]
11.	Explain the working of bench drilling machine and pillar drilling machine.	[2015s]

Chapter No-10 (Module - IV)

Name of the Chapter:- Surface Finish, Lapping

Questions Booklet

Group.-A

1	Define Lapping?	[2014,2011]
2	What is the purpose of doing surface finishing operations?	[2011]
3	What are different super finishing operations?	[2009(s)]
4	Define Lapping?	[2014,2011]
5	Define surface finishoperation.	
6	What is the effect of cutting speed and feed of cut in the surface finish of a generated one?	
7	What is Honing?	

Group-B

1	What different surface finishing operations you know? How are they classified?	
2	Differentiate between Lapping and honing?	
3	What is Honing? Explain its utility.	
4	What is lapping ? Briefly explain.	
5	Describe the process of Super finishing with neat diagram.	[2009(s), 2015s]
6	Describe surface finish operations briefly.	[2016s]

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THERMAL ENGINEERING - II (MET- 403)

Chapter No. - 1 (Module - I)

Questions Booklet

Group –A

1. What is the difference between gas and vapour? [2011(S), 2009W, 2015sp]
2. What is steam and what are the different types of steam. [2013(s)]
3. What are the main components of steam power plant ? [2015s]
4. Define Rankine cycle. 2009BP
5. What are the different types of steam ? Which steam is invisible to naked eye ? [2013s]
6. Draw the P-V diagram of carnot cycle. [2011s]
7. What are the reasons for modification of Rankine Cycle ? [2015-S]
8. Draw the P-V,T-S diagram of Rankine cycle. [2015sp]
9. What are the main components of a steam power plant working on rankine cycle ?
10. What is the defference between carnot vapour cycle and rankine cycle
11. Draw the P-V and T-S Digram of modified rankine cycle.
12. Draw T-S diagram for Binary Vapour Cycle.
13. What are the working fluid used in binary vapour cycle

Group-B

1. What are the advantages of steam as a working fluid ?
2. Describe carnot vapour cycle with steam with the help of P-V & T-S diagram & deduce a formula for its thermal efficiency. [2015-S]
3. Carnot cycle is not used as a standard reference cycle in any steam power plant why ?
4. A carnot engine working between 650k and 310k produces 150KJ of work.Find thermal efficiency and heat added during the process. **Ans.: 52%, 286.76 Kj**
5. What is the difference between carnot vapour cycle and Rankine Cycle ?
6. Describe rankine cycle with the help of P-V, T-S & H-S diagrams and decuce a formala for its thermal efficiency considering feed pump work. [2015sp]
7. Describe modified Rankine cycle with the help of P-V, T-S & H-S diagrams & deduce a formula for its thermal efficiency.
8. A steam power plant has the range of operation from 40 bar dry saturated to 0.05 bar. Determine,
   i) the cycle efficiency ii) work ratio.
   Carnot cycle and Rankine cycle. **Ans. 35.62%, 85%, 0.995** [2013S]
9. A steam power plant supplied with dry saturated steam at a pressure of 12 bar and exhausts in to a condenser at 0.1 bar calculate the Rankine efficienly by using i) steam table & ii) Mollier chart. **Ans. 27.7%, 27.8%** [2011-S]
10. A simple Rankine cycle works between pressures of 28 bar and 0.06 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency work ratio & specific steam consumption rate. (M. M. Rathor Q.-3) **Ans. : 33.57%, 0.997, 4.049 kg/kwh**

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11. The following data refer to a steam turbine working on Rankine cycle.
Admission pressure = 14.5 bar
Condenser pressure = 0.3 bar
Quality of steam admitted = super heated temp. being 250°C.
Determine thermal efficiency of the turbine considering feed pump work.
Ans : 25%

12. Dry saturated steam at a pressure of 20 bar is suplied to a steam power plant where it expands a pressure of 2 bar. The steam is then released at constant volume until the pressure drops to bar. Determine efficiency of modified Rankine cycle -
i) taking feed pump work into consideration, and
ii) neglecting feed pump work.
Ans : 20.93%, 20.99%

13 In a steam power cycle, the steam supply is at 15 bar, dry & saturated. The condenser pressure 0.4 bar calculate the Carnot & Rankine efficiencies of the cycle. Neglect pump work.
Ans : 25.9%, 23.54%

14. Superheated steam enters into a steam turbine at a pressure of 2.0 MPa, the degree of superh being 120°C. Steam expands in the turbine isentropically to pressure of 0.05 bar. If the turb works on Rankine cycle, determine -
i) heat supplied per kg of steam
ii) heat rejected per kg of steam
iii) net work done per kg of steam during a cycle, and
iv) thermal efficiency of Rankine cycle.
Ans : 2913.2 kJ / kg, 1911.75 kJ / kg, 1001.45 kJ, 34.37%

15. Give the layout of steam power plant.

[2016

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Chapter No-2 (Module - II)

Name of the Chapter:- Gas Power Cycles

Group – A

1. Show the P-V and T-S diagram of Otto cycle. [2012w]
2. List two advantages of two stroke cycle engine over a four stroke one. [2010(w)]
3. What do you mean by internal combustion engine? [2012w]
4. What is the difference between I.C engine and steam engine ? [2015-S]
5. Name the air standard cycle for petrol engine.
6. Show the P-V and T-S diagram of diesel Cycle.
7. What is CI engine? [2010(w)]
8. Define the compression ratio of IC engine.
9. Mention the relation between compression ratio, clearance volume and swept volume.
10. What is Internal combustion engine ? [2016s]
11. Draw P-V and T-S diagranm of dual cycle.
12. Which reciprocating IC-engine 2S or 4S is more efficient & why.
13. State the expression of air standard efficiency of otto cycle.
14. State the expression of air standard efficiency of diesel cycle.
15. State the expression of air standard efficiency of dual cycle.

Group-B

1. Describe Otto cycle with the help of P-V and T-S diagram and deduce a formula for its thermal efficiency. [2015-S]
2. Explain working of 4-stroke petrol engine [2011(w)]
3. Distinguish between two-stroke and four stroke engine. [2010(w), 2015s, 2016s]
4. What is the difference between petrol engine and diesel engine ?
5. What is the difference between a steam engine and an I.C. Engine ? [2015s]
6. In an engine working on an ideal Otto cycle, the temperatures at the beginning and at the end of compreson are 27°C and 327°C. Find the compression ratio and air-standard efficiency of the engine.
   Ans : 5.65, 50.02%
7. Compare Otto, Diesel and Dual cycles for given compression ratio.
8. Describe Diesel cycle with the help of P-V and T-S diagrams and deduce a formula for its ideal thermal efficiency.
9. Describe Dual combustion cycle with the help of P-V nad T-S diagrams and deduce a formula for its ideal thermal efficiency.
10. Find the air standard efficiency of petrol engine working on Otto cycle if the maximum temperature of the cycle is 2000°C and temperature at the end of expansion is 800°C.
    Ans : 52.8%

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11. An engine working on a Carnot cycle receives heat at 800°C and rejects heat at 30°C. F
efficiency of the cycle. If the engine receives 5000 kJ of heat per minute from the source, ca
the power developed by the engine. Ans : 59.80kW. [2018

12. An engineer claims that his engine can develop 3.678 kW. The engine consumes 0.40 kg
per hour having calorific value of 42000kJ/kg. The maximum temperature and minimum temps
recorded are 1400°C and 350°C respectively. State whether the engineer is justified in his
Ans : The engineer is not justified in his claim

13. An air engine working on the Otto cycle has compression ratio raised from 5 to 6.Compa
change in efficiency due to this rise in pressure . **Ans. 7.78%** [2010(

14. An engine working on the Otto cycle has a cylinder diameter of 170 mm and stroke or 250
The clearance volume is 1.15×10^{-3} m^3. Find the air standard efficiency of this engine. (Take γ
Ans. 49.5% [2012

15. The following data relate to an engine working on Diesel cycle. Cylinder bore = 200 mm; P
stroke = 300 mm; Clearance volume = 800000 mm^3. Cut off takes place of 6% of stroke vol
Determine -

    i) Compression ratio ii) Cut off ratio

    iii) Air standard efficiency of the cycle.

Ans : 12.781, 1.71, 56.87%

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Chapter No-3 (Module - II)

Name of the Chapter :- Fuels and Combustion

Group A

1. Define hydrocarbon fuel. [2016S]
2. Name types of fuel and mention two example each. [2011(w)]
3. Define calorific value of fuel. [2012w]
4. Define stoichiomatric combustion.
5. Define heating value of fuel.
6. What do you mean by complete combustion.
7. What do you mean by in-complete combustion.
8. Define octane number [2015-S]
9. Define cetane number
10. What is theoritical combustion.

Group B

1. Write down the important combustion reactions.
2. Explain complete combustion with the help of combustion equation.
3. Define Enthalpy of formation and Enthalpy of combustion. [2015-S]
4. Natural gas (100% CH_4) obtained from a certain source is burnt with dry air in stoichiometric combustion. Establish the stoichiometric equation and evaluate the air- fuel ratio by volume. [P. Chatopaddhaya Ex.13.1] **Ans : 9.25**
5. In a certain combustion process, ethane is burns with 20% excess air. The combustion is complete one that is carried out at a total pressure of 100 kPa.
   Determine the air-fuel ratio. [P. Chatopaddhaya Ex. 13.3]
   Ans : 19.2189 [US]
6. Methane is combusted with 100% theoretical dry air (298K/1 atm). Determine the
   a) enthalpy of reaction
   b) enthalpy of combustion
   c) heat of combustion
   d) LHV
   e) HHV [P. Chatopaddhaya Ex. 13.7]

   Ans : –802306kJ/kmol, –802306kJ/kmol, –802306kJ/kmol, 802306kJ/kmol, 890182kJ/kmol

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Chapter No - 4 (Module - III)

Name of the Chapter:- Heat Transfer

Group A

1. Define heat transfer.
2. Name the modes of heat transfer.
3. Define thermal conductivity.
4. What is a heat exchanger?
5. State Kirchoff's law.
6. State Stefan Boltzman law.
7. Define the fourier law of Heat conductions.
8. Write Fourier law of heat conduction.
9. Define Newton's law of cooling.
10. What is maxwell theory.
11. What is max planck theory.
12. Define absorptivity.
13. Define Reflectivity.
14. What is heat exchanger ? Write its two applications.
15. Define black body.

Group B

1. Explain shortly various modes of heat transfer.
2. Define and explain the concept of Fourier's law and thermal conductivity.
3. Define Fourier's law of heat conduction and Newton's law of cooling.
4. Derive the expression for heat flowrate in case of Hollow Cylinder with sketch.
5. Determine the heat flow across a plane wall of 10 cm thickness with a thermal conductivity of W/m.K, when the surface temperatures are steady and at 200°C and 50°C. The wall area is 2 Also find the temperature gradient in flow direction.
   Ans : 25500W, 1500°C/m
6. Determine the heat transfer rate by convection over a surface of 1m² if the surface at 100°C exposed to a fluid at 40°C with convection coefficient of 25 W/m²K.
   Ans : 1500 W
7. Derive the expression for heat flowrate in case of plane wall.
8. A boiler is made up of iron plates 12 mm thick. If the temperature of the outside surface be 12 and that of the inner 100°C, calculate the mass of water evaporated per hour. Assume that area of heating surface is 5 m² and thermal conductivity of iron is 84 W/mK.
   Ans : 1115kg
9. A 6 cm OD, 2 cm thick copper hollow sphere [k = 386 W/m°C] is uniformly heated at the in surface at arate of 150 W/m². The outer surface is cooled with air at 20°C with a heat-trans coefficient of 10 W/m².°C. Calculate the temperature of the outer surface.
   Ans : 21.7°C
10. A metal pipe of 10 cm OD is covered with a 2 cm thick insulation [k=0.07W/m°C]. The heat l from the pipe is 100 W per meter of length when the pipe surface is at 100°C. What is temperature of the outer surface of the insulation?
    Ans : 23.5°C

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Chapter No-5 (Module - IV)

Name of the Chapter :- Refrigeration Cycles

Question Booklet

Group A

What is concept of Refrigerator and heat pump ? [2015-S]

Differentiate between heat engine & refrigerator.

Define COP of regrigerator.

State the relation between COPs of refrigerator & heat pump working between same temperature limits.

Define 'tonne of refrigeration'

Draw P-V & T-S diagram of a reversed carnot cycle. 2012(w)

Name the operations in vapour compression cycle.

State expression for COP of Gas refrigeration cycle.

Draw P-V diagram of Bell Coleman cycle. 2010(s)

). State expression for COP of reversed carnot cycle.

l. Name the operation in bell Coleman cycle / reversed Brayton cycle.

Group B

An inventor claims to have developed a refrigerating unit which maintains the refrigerated space as -05°C which is operating in a room where temp. is 26 °C & has a COP of 8.4 . find out whether his claim is correct or not

What is reversed Carnot cycle ? Derive the expression for COP for refrigeration system. [2016s]

Deduce a formula for C.O.P. of Bell-Coleman cycle in terms of pressure ratio.

Name the important elements of vapour compression refrigeration and state their functions.

What are the advantages and disadvantages of vapour compression refrigeration over air refrigeration ?

Define refrigeration effect. What is one tonne of refrigeration ? What is the basic formula for calculating the tonnage of refrigeration ?

Draw block diagram of ideal vapoour compression cycle & explain with the help of T-S & P-H diagram. [2016S, 2015S]

A refrigerating system operates on the reversed carnot cycle. The higher temp. of the refrigerant in the system is 35° C & the lower temp. is -15° C. The capacity is also 12 Tonne neglect all losses. Determine (a) COP (b) heat rejected from the system (c) power required

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FLUID MECHANICS AND HYDRAULIC MACHINES (MET- 404)

Chapter No. - 1 (Module - I)

Properties of Fluid

Questions Booklet

Group –A

1 Define fluid [2010(w), 2013w]

2 Define sp. Wt & state its units

3 Define sp.gravity [2011, 2015 (S)]

4 Define viscosity [2010(w)]

5 State Newton's law of viscosity [a-5pg-29]S

6 What is Newtonian fluid? [2012(w)]

7 State the relation between kinetic viscosity & dynamic viscosity of a liquid

Group-B

1 A volume of 2.5m³ of certain fluid weighs 9.81 KN. Determine the specific weight, mass density and specific gravity of liquid. **Ans. 3.924N/m³, 400kg/m³, 0.4** [2015(S)]

2 Convert intensity of pressure of 20 kPa into equivalent pressure head of oil of specific gravity 0.9. **Ans. 22.65m** [2016s]

3 The velocity distribution for flow over a flat plate is given by $u = \frac{3}{2}y - y^{3/2}$, where u is the point velocity in meter per second at a distance y meter above the plate. Determine the shear stress at y = 9 cm. Assume dynamic viscosity as 8 poise. **Ans. 0.84N/m²**

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Chapter – 2 (Module - I)

Fluid Pressure and its Measurements

Questions Booklet

Group –A

1. State Pascal's law
2. What is the difference between gauge pressure and absolute pressure? [2010(w
3. What is the use of manometer ?
4. Write different types of manometer ?

Group-B

1 What is intensity of pressure? Explain absolute pressure, gauge pressure and atmosph pressure and state their relationship. [2012(w

2 Determine the gauge and absolute pressure at a point which is 2.0m below the free surfac water. Take atmospheirc pressure as 10.1043 N/cm². **Ans. 1.962N/cm², 12.068N/cm²**

3 Explain the working of Bourden Tube pressure gauge. [2015 (w

4 A simple manometer (U- tube) containing mercury is connected to a pipe in which an oil of Gravity of 0.8 is flowing. The pressure in the pipe is vacuum. The left limb of the manomete connected to pipeline and right limb is open to atmosphere. Find the vacuum pressure in the pi if the difference of mercury level in the two limbs is 20 cm and the height of the oil in the left limb 15 cm below the center of the pipe. **Ans. -2.786N/cm²** [2012(w

5 A U-tube differential manometer connect two pr.pipes A&B.The pipe A contains a liquid hav sp.gravity 1.4 under a pr. Of 100Kpa.The pipe B contains oil of sp.gravity 0.8 under a pr. Of 2 Kpa.The pipe Alies 2.5m above pipe B.Find the difference of pr.measured by Hg as fluid filling tube. **Ans. 53.12cm**

6 A simple manometer is used to measure the pressure of oil (sp.gr.=0.8) flowing in pipe line. right limb is open to the atmosphere and left lime is connected to the pipe. The centre of the p is 9cm below the level of mercury (sp.gr. 13.6) in the right limb. If the difference of mercury leve the two limbs is 15 cm, determine the absolute pressure of the oil in the pipe in N/cm². [2011

Ans. 12.01N/cm²

[2012w

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Chapter – 3 (Module - I)
Hydrostatics

Group –A

1. Define buoyancy. [2011, 2012w, 2013w]
2. Define center of buoyancy. [2013w]
3. State Archimedes's principle. [2010, 2015(w), 2013w]
4. What do you mean by metacenter?
5. What do you mean by metacentric height?
6. Define hydrostatic pressure. 2013w
7. Define center of pressure and total pressure. [2010(w), 2011, 2012w]
8. State expression for total pr.on a plane immersed in liquid.
9. State expression for depth of centre of pr. Of a plane immersed in liquid.

Group-B

1. Write short note on Buoyancy and Center of Buoyancy. [2010(w)]
2. A rectangular body of 6m long,4m wide and 1.5m deep is immersed in seawater. Find the metacentric height of body take specific gravity as 0.7. **Ans. 1.04m** [2011]
3. With diagram explain meta center and meta centric height. [2012(w)]
4. Derive the expression for total pressure and center of pressure for a submerged vertical plate. [2012(w)]
5. A stone weighing 490.5N in air and 196.2N in water. Determine the volume of stone and the specific gravity. **Ans. 0.03m^3, 1.67**
6. A rectangular lamina is 1.2 m wide and 2.2m deep is held vertically immersed in water so that its upper edge is horizontal and 1.6m below the free water surface. Determine the total pressure on the lamina and depth of centre of pressure. **Ans. 69925.6N, 2.84m** [2016S
7. A Block of wood of specific gravity 0.8 floats in water. Determine the metacentric height of the block if its size is 3mt x 2mt x 1mt. **Ans. 0.3166m** [2013w]
8. Determine the total pressure and centre of pressure on an isosceles triangular plate, plate of base 5m and altitude 5m. When the plate is immersed vertically in an oil of spelitic gravity 0.8. The base of plate is 1m below the free surface. **Ans. 260946N., 3.18m.** [2015 (s)]

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Chapter – 4 (Module - 2)

Fluid Flow

Group –A

1 Define steady flow and unsteady flow. [2010(w),2011, 2013,
2 What is the difference between steady flow and unsteady flow? [2012(w, 1
3 Define uniform and non uniform flow. [2011, 2013,
4 Define laminar and turbulent flow. [2011, 2013, 2
5 Define compressible and incompressible fluid. [201 3
6 Define rotational and irrotational fluid flow. [201 4
7 Define pressure energy. [201 5
8 State Bernoulli's theorem. [2013,
9 Name the applications of Bernoulli's theorem.
10 State the function of a Venturimeter.
11 State expression for discharge through venturimeter.
12 What is Pitot tube and state its function? 2009(S) 2010(
13 Define orifice. [2012w, 2013
14 Differentiate between small & large orifice.
15 Define co-efficient of discharge [201
16 Write the relation among Cd, Cv, & Cc. [[2010(w
17 Define venacontracta.

Group-B

1. Water is flowing through a pipe having dia.300mm and 200mm at the bottom end and upper en respectively.The intensity of pr.at the bottom end is 24.525 N/cm2& pr.at the upper end is 9.81 N cm2.Determine the diff.in datum head if rate of flow through pipe is 40lit/sec. [2010(w **Ans. 13.70m**
2. A 40 cm diameter pipe, conveying water, branches into two pipes of diameters 30 cm and 20 c respectively. If the average velocity in the 40 cm diameter pipe is 3 m/s. Find the discharge in this pip Also determine the velocity in 20cm pipe if the average velocity in 30 cm diameter pipe is 2 m/s. **Ans. 0.2356m³/s, 7.5m/s**
3. Define venturimeter and derive an expression for discharge through venturimeter. [2015(s
4. State and prove equation of continuity. [2011, 2015 (s
5. Establish relation between orifice co-efficients. [2011, 2013w
6. State and prove Bernoulli's equation, write its assumptions and limitations.[2009(S)],[2010(w),201
7. A pipe through which water is flowing is having diameters 20cm and 10cm at the two cross sections (1) and (2). The velocity of water at section(1) is 4.0 mt/sec. Find the velocity head a sections (1) and (2) and also the rate of discharge. **Ans. 0.8154m, 13m, 0.1256m³/s.** [2013(w
8. Water is flowing through a pipe having diameters 30 cm and 15 cm at the bottom and upper en respectively. The intensity of pressure at the bottom end is 29.40 N/cm² and the pressure at th upper end is 14.715 N/cm². Determine the difference in datum head if the rate of flow through th pipe is 50 lt./sec. **Ans. 14.614m**
9. A venturimeter having diameter of 100 mm at the throat and 175 mm at the enlarged end is installe in a horizonatal piipeline of 175 mm in diameter carrying an oil of sp. gravity 0.95. The difference pressure head is 180mm of Hg. Determine the discharge through the pipe, if C_4=0.97. [2016 **Ans. 0.05m³/s**

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Chapter – 5 (Module - III)
Flow Through Pipes

Group –A

1 State and write the Darcy's formula for the head lost in friction for flow through pipe with all notations [2011, 2013w]

2 Mention Chezy's formula for flow through pipe.

3 Explain Hydraulic gradient line. [2010(w), 2012w, 2013w]

4 What is total energy line? [2011, 2013w]

5 What is value of 'Re' for a laminar & turbulent flow of fluid.

6 Mention head losses in flow through pipes. [2015 (W)]

Group-B

1 Show that the loss of head due to sudden expansion in a pipeline is function of velocity head. [2015 (S)]

2 The discharge through a pipe is 200 liters/s. Find the loss of head when the pipe is suddenly enlarged from 150 mm to 300 mm diameter. **Ans.3.672** [2015(S)]

3 Find the head loss due to friction in a pipe of diameter 250 mm and length 60 m, through which wate is flowing at a velocity of 3.0 m/s using (i) Chezy's formula ii) Darcy's formula, for which C = 55. Take υ for water = .01 stoke. **Ans. (i) 1.182, (ii) 2.856**

4 A reservoir has been built 4 km away from a college having 5000 inhabitants.water is to be supplied from the reservoir to the campus.it is estimated that each inhabitant will consume 200lt. per day & that half of daily supply is pumped within 10hrs. Calculate the size of supply main if the loss of head due to friction in pipe line is 20m.Assume coefficient of friction for pipe line is 0.008.

Ans. d=39mm

5 Find the loss of head due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/sec using (i) Darcy formula (ii) Chezy's formula. Take C=60 and f = 0.008. **Ans. i)16.66m, ii) 24.46m** [2012(w)]

6 Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using (i) Darcy's formula, ii) Chezy's formula for which C = 60 Take υ for water = .01 stoke. **Ans. 0.7828m, 1.665m.**

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Chapter – 6 (Module - II)

Impact of Jet'

Group –A

1. State expression for impact of a jet an fixed vertical plate
2. State the expression for impact of jet an fixed inclined place along the direction of jet
3. State the force exerted due to the jet striking centrally on fixed curved plate to the direction of je
4. What is condition of maximum hydraulic efficiency when a jet strike on a series of flat blade mounted on rim of a cylinder ? [2010(w), 2013, [2012(w
5. Define hydraulic efficiency for a moving plate.

Group - B

1. Draw velocity triangles for jet impinging tangentially in a moving curved vane state expression work done. [2011, 2013
2. A jet of water of dia.75mm moving with avelocity of 25m/sec strikes a fixed plate in such a way th the angle between the jet and plate is 60.Find the force exerted by the jet on the plate (a) in t direction normal to plate (b) in the direction of the jet. **Ans. a) 2390.7N, b) 2070.4N** [2010(
3. A jet of water 40mm diamater moving with a velocity of 120 m/sec impinging on a series of var moving with a velocity of 5m/sec. Find the force exerted, work done and efficiency. [2(**Ans. 17.3459KN, 86.7KW, 8%**
4. A jet of water of dia.7.5cm strikes a curved plate at its centre with a velocity of 20m/sec.T curved plate is moving with a velocity of 8m/sec in the direction of the jet.The jet is deflec through an angle of 165.Assuming the plate smooth find:
   (a) Force exerted on the plate in the direction of jet **Ans. 1250.38N**
   (b) Power of the jet **Ans. 10KW**
   (c) Efficiency of the jet **Ans. 56.4%** [2010(
5. A jet of water of diameter 50mm strikes a fixed plate in such a way that the angle between the pl and the jet is 30°. The force exerted in the direction of the jet is 1471.5 N. Determine the rate flow of water. **Ans. 107.5 lit/sec.**
6. A jet of water of diameter 50 mm having a velocity of 20 m/sec strikes a curved vane which moving with a velocity of 10 m/sec in the direction of the jet. The jet leaves the vane at an angle 60° to the direction of motion of vane at outlet. Determine
   i) The force exerted by the jet on the vane in the direction of motion **Ans. 294.4N**
   ii) Work done per second by the jet **Ans. 2944.5KW**
7. A jet of water of diameter 50 mm, having a velocity of 30 m/s strikes a curved vane which is mov with a velocity of 15 m/s in the direction of jet. The jet leaves the vane at an angle of 60° to direction of motion of vanes at outlet. Determine : (i) force exerted by the jet on vane in the direc of motion, (ii) work done per second by the jet. **Ans. i) 662.5N, ii) 9.9375KW** [2012(

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9. In an inward flow reaction turbine the internal is external diameters are 0.85m &1.2m resp. The width of the impuller is 160mm. The turbine is working under a head of 12m & hydraulic efficiency is 90%. If the vase angle at outlet is 20° & flow velocity is 3m/sec. Find the discharge & power developed by the turbine. **Ans. 1.8m³/s, 19080W.** 2013(s)

10. A pelton wheen turbine produces 20mw while running at 700 rpm. Under a effective head of 1700m. Calculate (i) least diameter at the jet (ii) mean diameter of Runner and (iii) Number of Buckets.

Ans. 103.17mm, 1037.1mm, 15 [2015 (S)]

11. A inward flow reaction turbine has external and internal diameter 1 m and 0.6 m respectively. The hydraulic efficiency of turbine is 90% when the operating head is 36m. The velocity of flow at outlet is 2.5 m/s and discharge at outlet is radial. If the vene angle at output is 15° and width of the wheel is 100 mm at inlet and outlet determine

(i) Guide blade Angle (ii) Speed of the turbine

(iii) vane angle of the runner at inlet (iv) Power developed. [2015 (S) BP]

Ans. i) 4°19', ii) 296.98RPM, iii) 17°05', iv) 149.7KW

12. A plton wheel has mean bucket speed of 14 m/sec with a set of water floming under a head of 110m. If the set is deflected through an angle of 165° & the coefficient of velocity is 0.97, find the hydraulic efficiency of the turbine. **Ans. 84.20%** [2013(s)]

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Chapter No-8 (Module -)
Name of the Chapter:-Hydraulic Pump

Group – A

1 Define a hydraulic pump. Name a positive displacement and a roto dynamic pump. [2012S(N)]
2 Write the types of cosing in a centrifugal pump.
3 State expression for overall efficiency of a centrifugal pump. [2012S(N)]
4 Define the terms suction head & delivery head.
5 Define the terms static head & manometric head.
6 What do you mean by manometric efficiency of a centrifugal pump? [2011, 2014s, 2015-S, BP]
7 Define centrifugal pump [2011]
8 Explain slip. [[2010(s), 2011]
9 State positive & negative slip.
10 Define a reciprocating pump. [2011]
11 Differentiate between a single cylinder & double cylinder reciprocating pump.
12 Differentiate between single acting & double acting reciprocating pump. [2012s, 2014s]
13 Define cavitation.

Group-B

1. Explain volute and vortex casing. (2012S)
2. Write down the working of multistage pump.
3. Describe construction & working of a centrifugal pump. [2012S(N)]
4. A centrifugal pump delivers water against a head of 14.5 metres while running at 1000 rpm. The vanes are curved back at an angle of 30° with the periphery. The impeller diameter is 300 mm and outlet width is 50mm. If the manometric efficiency of the pump is 85%, find the discharge of the pump. **Ans. 0.237m³/s** [2014s]
5. A double acting reciprocating pump, running at 50 rpm is discharging 900 litres of water per minute. The pump has a stroke of 400 mm. The diameter of piston is 250 mm. The delivery & suction heads are 25m & 4m respectively. Find the slip of the pump & power required to drive the pump. **Ans. 0.0177m³/s, 0.775KW** 2012S(N)
6. A centrifugal pump is to discharge water at the rate of 110 liter / sec at speed of 1450 rpm against a head of 23 mts. The impeller dia. is 250 mm and with 50mm. If the manometric efficiency is 75% Determine the vane angle at outer periphery. **Ans. 43°12'** [2015 (S) BP]
7. Asingle acting Reciprocating pump running at 30 rpm delivers 0.02 m3/sec of water. The diameter of piston is 25cm and stroke length 50 cm determine.
   i) Theoretical Discharge of pump (ii) Coefficient of discharge
   iii) Slip and percentage of slip. [2015 (S)-BP]
   Ans. i) 0.012m³/s, ii) 1.66, iii) 0.01m³/s, 66%
8. A centrifugal pump of 325 mm diameter running at 1100 rpm develops a head of 20m. The vanes are curved back at an angle of 30° to the tangent at outlet. If the velocity of flow is constant at 2.5 m/s, find the manometric efficiency of the pump. **Ans. 72%** [2013(s)]

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THEORY OF MACHINE (MET - 401)

Module - I

a) **Define kinematic link. Mention its types.** [2

b) With neat sketch, explain crank and slotted lever quick return mechanism. [5

c) Write notes on complete and incomplete constrained motion in lower and higher pairs. Illustrate the answer with neat sketch. [7

a) Define kinematic pair. [2

b) In a crank and slotted lever mechanism (quick return), the distance between the fixed centres is 180 mm and the driving crank is 90 mm long. Determine the ratio of the time taken on the cutting and return strokes. [5

c) Explain four bar mechanism with their inversion [7

a) Define lower pair. [2

b) What do you mean by lower pair and higher pair ? Give two examples from each. [5

c) What is kinematic pair? Explain the types of kinematic pair with examples. [7

a) What is the difference between lower pair and higher pair? [2

b) Sketch and describe slider crank mechanism. [5

c) With neat sketh explain whithworth's lever quick return mechanism. [7

a) Define Governor. [2

b) Explain the working of a porter governor. [5

c) Find an expression for maximum fluctuation of energy in terms of mean K.E and coefficient of fluctuation of speed. [7

a) Write down the classification of governor. [2

b) Explain the working principle of Hart Nell governor with neat sketch. [5

c) The mass of flywheel is 5 tonnes and the radius of gyraton is 1.5m. The fluctuation of energy is 50kN.m. Find the maximum and minimum speed of the engine for a mean speed of 200 rpm. **Ans. : 21.04 rad / sec, 20.84 rad / sec** [7

a) What is the function of governor? [2

b) The length of the upper arm of a watt governor is 500mm and its inclination to the vertical is 250.Find the percentage increase in speed,if belt rises by 23mm. **Ans.: 2.77%** [5

c) A vertical double acting steam engine develops 7.5kw at 250 rpm. The maximum fluctuation of energy is 25% of the work done per stroke. The maximum and minimum speeds are not to vary more than 1% on either; side of the mean speed. Find the mass of the flywheel required whose radius of gyration is 0.5m. **Ans.: 131.31 KG** [7

a) Draw the watt governor diagram. [2

b) Working of watt Governor Write short note on it. [5

c) The turning moment diagram for a multicyliner engine has been drawn to a scale of 1 mm = 4500 N-m vertically and 1 mm = 2.4° horizontally. The intercepted areas between output torque curve and mean resistance line taken in order from one end are 342, 23, 245, 303, 115, 232, 227, 164 mm^2, when the engine is running at 150 r.p.m. If the mass of the flywheel is 1000 kg and the total fluctuation of speed does not exceed 3% of the mean speed, find the minimum value of the radius of gyration. **Ans. R=1.034m** [7

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THEORY OF MACHINE (ME[illegible])

Module - II

1. a) Define angle of repose. [2
   b) Derive the expression for horse power lost & troque transmitted in friction in case of flat collar bearing considering uniform pressure. [5
   c) A vertical shaft supports a load of 20 kN in a conical pivot bearing. The external radius of the cone is 3 times the internal radius and the cone angle is 120°. Assuming uniform intensity of pressure as 0.35 MN/m². determine the dimensions of the bearing. If the coefficient of friction between the shaft and bearing is 0.05 and the shaft rotates at 120 r.p.m, find the power absorbed in friction. **Ans. 47.7mm, 143mm, P=1.5KW** [7

2. a) Define a simple screw jack. [2
   b) Find the torque required to rotate vertical shaft resting on flat pivot bearing considering uniform wear. [5
   c) The thrust on the propeller shaft of a marine engine is taken up by 8 collars whose extenrnal and internal diameters are 660 mm and 420 mm respectively. The thrust pressure is 0.4 MN/m² and may assumed uniform. The coefficient of friction between the shaft and collars is 0.04. If the shaft rotates at 90 r.p.m : find 1, total thrust on the collars; and 2, power absorbed by friction at the bearing. **Ans. F=65.1KN, P=68KN** [7

3. a) Classify clutch [2
   b) Derive the formula for torque and power transmission in conical pivot bearing. [5
   c) A plate clutch has 10 operating faces with inner and outer diameters of 15 cm and 25 cm respectively. It runs at 1200 rpm with a total end load of 4500 N, the co-efficient of friction being 0.08. Find the maximum torque and power that can be transmitted in KW. Assume uniform wear condition. **Ans. T=360Nm, P=45.23KW** [7

4. a) Define a clutch. [2
   b) Explain single plate clutch. [5
   c) A thrust bearing has 4 collars of 600 mm external dia & 250 mm internal diameter. The total thrust from the shaft in 80 KN. If the co-efficient of friction is 0.2 and engines peed is 100 rpm. Find the power absorbed in friction assuming (i) Uniform pressure, (ii) Uniform wear. **Ans.: 37.617KW & 35.6 KW, P_1=37.61KW, P_2 = 33.6KW** [7

5. a) Diffrentiate between journal and bearing. [2
   b) Derive expression for frictional torque for a flat pivot bearing considering uniform pressure. [5
   c) A single plate clutch (both sides effective) is required to transmit 26.5 kW at 1600 r.p.m. The outer diameter of the plate is limited to 300 mm and intensity of pressure between the plates

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is not to exceed 68.5 kN/m². Assuming uniform wear [illegible] coefficient of friction 0.3, show that the inner diameter of the plates is approximately 90mm. [7

a) Define amplitude. [2

b) What is meant by "free vibration"? Explain the types of free vibration. [5

c) With neat sketch describe longitudinal, transverse and torsional free vibration. [7

a) Define time period. [2

b) Explain basic concept of longitudinal and Trans verse vibration with sketch. [5

c) Explain the terms under damping, critical damping and over damping. [7

a) Define and sketch torsional vibration. [2

b) Mention different types of vibration [5

c) Derive an expression for the frequency of free torsional vibrations for a shaft fixed at one end and carrying a load on the free end. [7

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THEORY OF MACHINE (MET - 401)

Module - IV

1. a) Define static and dynamic Balancing. [2

   b) Explain method of balancing of a single rotating mas by two masses revolving in different planes. [5

   c) Four masses A, B, C and D revolve at equal radii and are equally spaced along a shaft. The mass B is 7 kg and the radii of C and D make angles of 90° and 240° respectively with the radius of B. Find the magnitude of the mases A, C and D and the angular position of A so that the system may be completely balanced. [7

   Ans. m_1 = 5kg, m_2 = 6kg, m_3 = 4.67kg, α =205°

2. a) Why balancing is required for rotating and reciprocating parts? [2

   b) Explain the principle of balancing of reciprocating masses. [5

   c) The four masses, m_1, m_2, m_3 & m_4 are respectively, 200 kg, 300 kg, 240 kg and 260 kg. the corresponding radii of rotation are 20 cm, 15 cm, 25 cm and 30 cm and the angles are 45°, 75°, and 135°. Find the position and magnitude of the balance mass required if the radius of rotation is 20 cm. **Ans. m=11.6kg, α =201.48°** [7

3. a) What is partial balancing? [2

   b) State the cause and effect of unbalance. [5

   c) Four masses A,B,C and D are attached to shaft and resolve in the same plane. The masses are 12 kg, 10 kg, 18 kg and 15 kg respectively and their radii of rotations are 40 mm, 50 mm, 60 mm and 30 mm. the angular position of the masses B,C and D are 60°, 135° and 270°from the mass A. Find the magnitude and position of the balancing mass at radius of 100mm.

   Ans. R=7.56kg, α =87° [7

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THEORY OF MACHINE (ME : 401)

Module - III

a) Differentiate between total tension and centrifugal tension. [2

b) Write various types of belt drive. [5

c) Two parallel shafts 6 meters apart are provided with 300 mm and 400 mm diameter pulleys and are connected by means of a corss belt. The direction of rotation of the follower pulley is to be reversed by changing over to an open belt drive. How much length of the belt has to be reduced ? **Ans. L=203.6mm** [7

2. a) Define velocity ratio and speed ratio. [2

b) Derive ratio of tension in flat belt drive. [5

c) A leather belt 125 mm wide and 6 mm thick, transmits power from a pulley 750 mm diameter which runs at 500 r.p.m. The angle of lap is 150° and $\mu = 0.3$. If the mass of 1 m^3 of leather is 1Mg and the stress in the belt is not to exceed 2.75 MPa, find the maximum power that can be transmitted. **Ans. P=19KW.** [7

a) Define creep and slip. [2

b) Explain working principle of fast and loose pulley. [5

c) An open belt drive connects two pulleys 1.2 m and 0.5 m diameter on parallel shafts 3.6 m apart. The belt has amass of 1kg/m length and the maximum tension in it is not to exced 2 kN. The 1.2m pulley, which is the driver, runs at 200 r.p.m. Due to the belt slip on one of the pulleys, the velocity of the driven shaft is only 450 r.p.m. If the coefficient of friction between the belt and the pulley is 0.3,find : 1. Torque on each of the two shafts, 2. Power transmited, 3. Power lost in friction, and 4. Efficiency of the drive.

Ans. T_1 = 648.6Nm, T_2 = 270.25Nm, P=13.58KW, Power lost = 0.849KW, Efficiency = 93.75% [7

a) What is crowning of pulley [2

b) What do you understand by "gear train" . Discuss various types of gear trains. [5

c) Two parallel shafts are to be connected by spur gearing. The approximate distance between the shafts is 600mm. If one shaft runs at 120 rpm and the other at 360 rpm find the number of teeth on each wheel if the module is 8 mm. Also determine the exact distance apart of the shafts. **Ans. T_1 = 114, T_2 = 38, L = 608mm** [7

a) Define module [2

b) Explain why crowning of pulley is done? [5

c) Explain the working principle of

(a) Compound gear train

(b) Reverted gear train

(c) Epicyclic gear train [7

5. a) Define circular pitch in toothed gear. [2

b) Derive an expression for velocity ratio in a belt drive. [5

c) Two parallel shafts about 800mm apart are connected by spur gear, one shaft is run at 400rpm and other at 180rpm. Design the gears if the circular pitch is 40mm.

Ans.: D_1 = 496.55mm and D_2 = 1103.44mm [7

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MANUFACTURING TECHNOLOGY (ME : 402)

Module - I

1. a) State the purpose of providing rack angle and clearance angle.
   b) Explain the different types of coolants and Lubricants.
   c) What are the factors that affect tool life ? Briefly describe their influence.
2. a) Define cutting speed and feed.
   b) Explain cutting action of a chisel and hack saw blade.
   c) Explain tool geometry of a single point cutting tool with neat sketch.
3. a) What is the effect of cutting fluid on tool life?
   b) Why do you provide various tool angles on a cutting tool?
   c) Draw three view of single point cutting tool
4. a) Why lead screw in lathe is square threaded ?
   b) Draw a neat sketch of a capstan lathe,show all component on it
   c) Explain thread cutting mechanism normally carried out on a lathe.
5. a) What is depth of cut?
   b) Explain tailstock set over method for taper turning.
   c) Draw the tooling layout for preparation of a hexagonal headed bolt.
6. a) Write down the specification of a lathe.
   b) Explain different parts of lathe carriage. Brifly explain respective function.
   c) Describe the function of different components of turret lathe.
7. a) What is feed of cut ?
   b) Differentiate between capstan & Turret lathe
   c) Explain the indexing arrangements for turret head with neat sketch
8. a) Which is the most versatile M/C tool on a workshop why?
   b) Explain bar feeding mechanism with a neat sketch
   c) What are the different methods of taper turning in a lathe? Explain any two methods

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MANUFACTURING TECHNOLOGY (ME-402)

Module - II

1. a) State composition of 6-6-4-2 HSS tool ? [2
   b) Write down the various mechanical properties of cutting tool material. [5
   c) Name various cutting tool materials. Briefly describe one important tool material along with its characteristics and usability. [7
2. a) State properties of ceramics and CBN as tool materials. [2
   b) State the properties of high speed steel and write the composition of different types of high speed steel. [5
   c) Write down various tool materials composition with their physical properties and uses. [7
3. a) Define abrasive ? [2
   b) State function of ram & tool head in shaper. [5
   c) Sketch and describe the working of automatic table feed mechanism of a shaper [7
4. a) Define & draw the quick return mechanism. [2
   b) How do you classify the different types of shapers? [5
   c) Explain the quick return mechanism of a shaper through neat sketch. [7
5. a) What is the material of shaper tool? [2
   b) Draw the dia. of universal shaper machine and show the part of it [5
   c) Explain with a neat sketch the crank & slotted link mechanism of a shaper. [7
6. a) Differentiate between planer & shaper. [2
   b) What is a planner ? Describe its basic principle. [5
   c) Explain table drive mechanism of a planning machine [7
7. a) How do you classify planers? [2
   b) Enlist different parts of planning machine. [5
   c) Describe in brief the main parts of a planer. [7
8. a) Define speed, feed and depth of cut in ashaper. [2
   b) Explain with neat sketch the bar feeding mechanism [5
   c) Describe the function of planer with a neat sketch. [7

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MANUFACTURING TECHNOLOGY (MET-402)

Module - III

1.	a)	In which operation dividing head is used and for what?	[2
	b)	Compare between plain and universal milling machine	[5
	c)	Describe the different numerical indexing procedure in milling M/C	[7
2.	a)	Name four work holding devices used on milling M/C	[2
	b)	Describe the working of a universal dividing head with neat sketch.	[5
	c)	Describe the function of simple deviding head and universal dividing head.	[7
3.	a)	What is universal milling machine	[2
	b)	Describe the main parts of a slotting machine.	[5
	c)	Briefly explains the construction and working principle of a slotter?	[7
4.	a)	What is precession slotter?	[2
	b)	Explain the working of Slotter?	[5
	c)	How do you classify the slotting machines?	[7
5.	a)	Differentiate between a slotter & a vertical shaper	[2
	b)	Describe grit, grade, bond, structure in case of abrasive wheel ?	[5
	c)	Describe various grinding operations.	[7
6.	a)	What is centre less grinding?	[2
	b)	State criteria for selection of grinding wheels.	[5
	c)	Explain the working of cylindrical grinding m/c with diagram.	[7

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MANUFACTURING TECHNOLOGY (PCME-402)

Module - IV

a) Define broaching. [2

b) Differentiate bench drilling machine and pillar drilling machine. [5

c) With neat sketch describe the parts & function of a radial drilling machine. [7

a) What is the effect of cutting speed and feed of cut in the surface finish of a generated one? [2

b) Explain different types of broaching operations and their application. [5

c) Draw a neat sketch of a bench drilling machine and explain different parts. [7

a) What are different super finishing operations? [2

b) Differentiate between Lapping and honing? [5

c) Briefly explain the process of lapping. [7

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THERMAL ENGINEERING - II (ME[illegible]-403)

Module - I

1. a) What is the difference between gas and vapour? [2015s, 2011s, 2009w] [2
   b) What are the advantages of steam as a working fluid ? [5
   c) A steam turbine develops 5 kW, operating on an ideal Rankine cycle. It receives steam at 30 bar and 300°C and exhausts it to a condenser at a vacuum of 685 mm of Hg. The barometer reds 760 mm Hg. The condensate is then returned to the boiler by a feed pump. Calculate -
      i) Rankine cycle efficiency
      ii) Dryness fraction of steam entering the condenser
      iii) Mass flow rate of steam [M. M. Rathore ex.12.7] [7

   Ans : 32.86%, 0.785, 5.43 kg/s

2. a) What is steam and what are the different types of steam. [2013s] [2
   b) Describe carnot vapour cycle with steam with the help of P-V & T-S diagram & deduce a formula for its thermal efficiency. [2015s] [5
   c) The boiler pressure & condenser pressure in a Rankine cycle are 1.0MPa & 20 kN/m² respectively. Assuming that the admission steam is dry and saturated, determine thermal efficiency of the cycle. [2014s]

   Ans : 24.4% [7

3. a) What are the main components of steam power plant ? [2015s] [2
   b) Why is the efficiency of a carnot vapour cycle is greater than that of a Rankine cycle ? [5
   c) A steam power plant operates ideally in the simple ideal Rankine cycle. Steam (3MPa / 623 K) enters the turbine and after expansion is exhausted to a total condenser operating at a pressure of 75 kPa. Determine the thermal effeciency of this cycle. [P. Chatopaddhaya Ex. 9.3]

   Ans : 26.01% [7

4. a) Define Rankine cycle. [2009]
   b) Carnot cycle is not used as a standard reference cycle in any steam power plant why ? [2
   c) Dry saturated steam at a pressure of 20 bar is suplied to a steam power plant where it expands to a pressure of 2 bar. The steam is then released at constant volume until the pressure drops to 0.5 bar. Determine efficiency of modified Rankine cycle -
      i) taking feed pump work into consideration, and
      ii) neglecting feed pump work. [5

   Ans : 20.93%, 20.99%

5. a) What are the different types of steam ? Which steam is invisible to naked eye ? [7
   b) Describe modified Rankine cycle with the help of P-V, T-S & H-S diagrams & deduce a formula for its thermal efficiency. [2
   c) A steam power plant operates ideally in the basic Rankine cycle. It receives 4MPa steam from the boiler firing coal to liberate heat at a steady rate of 100 MW. The steam after expansion in the turbine is exhaustead to a condenser that operates at 7.5 kPa. calculate the
      i) cycle efficiency, ii) work ratio for the cycle, iii) power output (MW) of the plant. [5

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iv) mass flow rate of the working fluid, v) specific steam consumption.
[P. Chatopaddhaya Ex. 9.4] **Ans. 34.51%, 0.9956, 34.51Mw, 136986Kg/h, 3.969Kg/KWh**[7

a) Draw the P-V diagram of carnot cycle. [2011S] [2

b) Describe rankine cycle with the help of P-V, T-S & H-S diagrams and decuce a formala for its thermal efficiency considering feed pump work. [2015s,2016s] [5

c) A steam power plant supplied with dry saturated steam at a pressure of 12 bar and exhausts in to a condenser at 0.1 bar calculate the Rankine efficienly by using i) steam table & ii) Mollier chart. [2011s] **Ans. 27.7%, 27.8%** [7

a) What are the reasons for modification of Rankine Cycle ? [2015s] [2

b) A carnot engine working between 650k and 310k produces 150KJ of work.Find thermal efficiency and heat added during the process. **Ans.: 52%, 286.76 Kj** [5

c) A simple Rankine cycle works between pressures of 28 bar and 0.06 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency work ratio & specific steam consumption rate. [M. M. Rathor Q.3] **Ans. : 33.57%, 0.997, 4.049 kg/kwh** [7

a) Draw T-S diagram for Binary Vapour Cycle. [2

b) Describe binary vapour cycle with neat sketch & P-V, T-S diagram. [2016s] [5

c) The following data refer to a steam turbine working on Rankine cycle.
Admission pressure = 14.5 bar
Condenser pressure = 0.3 bar
Quality of steam admitted = super heated temp. being 250°C.
Determine thermal efficiency of the turbine considering feed pump work. **Ans : 25%** [7

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THERMAL ENGINEERING - II (MET-403)

Module - II

1. a) Show the P-V and T-S diagram of Otto cycle. [2012] [2
   b) A Diesel engine has a compression ratio of 18 and cut-off takes place at 5% of stroke. Calculate the air-standard efficiency by taking y = 1.4. [2015s] [5
   c) Compression ratio of dual combustion cycle using air as the working medium is 12. Pressure and temperature at the beginning of compression are 0.98 bar and 25°C. The temperature at the end of constant volume and constant pressure processes are 1150°C respectively. Determine
      i) Heat supplied per kg of air ii) Heat rejected per kg of air
      iii) Net work done per kg of air iv) Clearance factor

   Ans : 790.86 kJ/kg, 298.45kJ/kg, 492.4 kJ/kg, 0.091 [7

2. a) List two advantages of two stroke cycle engine over a four stroke one. [2010w] [2
   b) In a diesel engines working on diesel cycle, the compression ratio is 14. Cut off takes place at 6% of the stroke find the air standard efficiency.

   Ans : 60.5% [5
   c) The compression ratio of an ideal Diesel cycle is 15 and cut off ratio is 2. The pressure of air at the beginning of compression is 1 bar. The engine working on this cycle uses $3m^3$ of air per minute. Determine -
      i) power developed by the engine, and
      ii) heat supplied per minute

   Ans : 33.425kW, 3322.06 kJ / min. [7

3. a) Show the P-V and T-S diagram of diesel Cycle. [2
   b) Distinguish between two-stroke and four stroke engine. [2016s, 2015s, 2010] [5
   c) An engine working on Otto cycle, the cyliner dimensions are 250 mm x 180 mm. The clearance volume is $1400000mm^3$. Find the compression ratio and air standard efficiency.

   Ans : 5.38; 49%

4. a) Define the compression ratio of IC engine. [7
   b) Explain working of 4-stroke petrol engine [2
   c) The following data relate to an engine working on Diesel cycle. Cylinder bore = 200 mm; Piston stroke = 300 mm; Clearance volume = $800000\ mm^3$. Cut off takes place of 6% of stroke volume. Determine - [5
      i) Compression ratio ii) Cut off ratio
      iii) Air standard efficiency of the cycle.

   Ans : 12.781, 1.71, 56.87%

5. a) Mention the relation between compression ratio, clearance volume and swept volume. [7
   b) In an engine working on an ideal Otto cycle, the temperatures at the beginning and at the end of compreson are 27°C and 327°C. Find the compression ratio and air-standard efficiency of the engine. [2

   Ans : 5.65, 50.02%

[5

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c) An ideal diesel engine has a diameter of 150mm and stroke of 250mm. The clearance volume is 10per cent of the stroke volume. Determine the compression ratio and air standard efficiency of the engine if the cut-off takes place at 6 percent of the stroke. [2016s] [7

Ans. 11, 57.53%

a) Draw P-V and T-S diagranm of dual cycle. [2

b) Describe Otto cycle with the help of P-V and T-S diagram and deduce a formula for its thermal efficiency. [2015s] [5

c) An engine working on the Otto cycle has a cylinder diameter of 170 mm and stroke or 250 mm. The clearance volume is 1.15×10^{-3} m^3. Find the air standard efficiency of this engine. (Take $\gamma = 1.4$) [2012w] **Ans. 49.5%** [7

a) State the expression of air standard efficiency of otto cycle. [2

b) Find the air standard efficiency of petrol engine working on Otto cycle if the maximum temperature of the cycle is 2000°C and temperature at the end of expansion is 800°C.[US] [5

Ans : 52.8%

c) An engine working on a Carnot cycle receives heat at 800°C and rejects heat at 30°C. Find the efficiency of the cycle. If the engine receives 5000 kJ of heat per minute from the source, calculate the power developed by the engine. [2015s] [7

Ans : 59.80kW.

a) State the expression of air standard efficiency of diesel cycle. [2

b) Describe Dual combustion cycle with the help of P-V nad T-S diagrams and deduce a formula for its ideal thermal efficiency. [5

c) An engineer claims that his engine can develop 3.678 kW. The engine consumes 0.40 kg of fuel per hour having calorific value of 42000kJ/kg. The maximum temperature and minimum temperature recorded are 1400°C and 350°C respectively. State whether the engineer is justified in his claim. [7

Ans : The engineer is not justified in his claim

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THERMAL ENGINEERING

Module - III

1. a) Define hydrocarbon fuel. [2016s] [2
   b) Explain quality of IC engine fuels with octane number and cetane number. [2016s] [5
   c) Describe combustion reactions and explain concept of stoichiometric combustion. [7

2. a) Define stoichiomatric combustion. [2
   b) Methane is combusted with 20% excess dry air at 298 K/1 atm. Determine the enthalpy of the reaction, assuming that all the water that is formed exists as vapour. [P. Chatopaddhaya Ex. 13.7] **Ans : –802306kJ/kmol** [5
   c) The percentage composition of a producer gas by volume is as follows -

Carbon monoxide	-	28
Hydrogen	-	10
Methane	-	2
Carbon dioxide	-	5
Oxygen	-	1
Nitrogen	-	55

Calculate the minimum volume of air necessary for complete combustion of 100 cu. m of this gas.
Ans : 104.75cu.m [7

3. a) Define thermal conductivity. [2
   b) Determine the heat flow across a plane wall of 10 cm thickness with a thermal conductivity of 8.5 W/m.K, when the surface temperatures are steady and at 200°C and 50°C. The wall area is $2m^2$. Also find the temperature gradient in flow direction.
Ans : 25500W, 1500°C/m
   c) A 6 cm OD, 2 cm thick copper hollow sphere [k = 386 W/m°C] is uniformly heated at the inner surface at arate of 150 W/m^2. The outer surface is cooled with air at 20°C with a heat-transfer coefficient of 10 $W/m^2.°C$. Calculate the temperature of the outer surface. [5
Ans : 21.7°C

4. a) State Kirchoff's law. [7
   b) Determine the heat transfer rate by convection over a surface of $1m^2$ if the surface at 100°C is exposed to a fluid at 40°C with convection coefficient of 25 W/m^2K. [2
Ans : 1500 W
   c) Explain various theories of radiation, also explain Kirchoff's law relating to spectral emissive power to absorptivity. [2016s] [5

5. a) State Stefan Boltzman law. [2016s, 2015s, 2010w] [7
   b) Derive the expression for heat flowrate in case of Hollow Cylinder with sketch. [2016s, 2015s] [5

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c) A steam pipe 20 m long, 100 mm internal dia and 40 mm thick is covered by a layer of lagging of 25 mm thick. The co-efficient of thermal conductivities for the pipe material and lagging are 0.07 W/mK and 0.1 W/mK respectively. If the steam is conveyed at a pressure of 17 bar with 30°C superheat and the outside temperature of the lagging i.e, 24°C, determine (i) the heat loss per hour (ii) the interface temperature. [2015s]
(Neglect the press drop accross the steam pipe).

Ans : 8776.8kJ/h, 71.6°C

a) What is maxwell theory. [7

b) What is Heat Exchanger ? Discuss about various types of Heat Exchangers. [2015s, 2016s] [2

c) A metal pipe of 10 cm OD is covered with a 2 cm thick insulation [k=0.07W/m°C]. The heat loss from the pipe is 100 W per meter of length when the pipe surface is at 100°C. What is the temperature of the outer surface of the insulation? [5

Ans : 23.5°C

a) Write fourier law of heat conduction. [2015s] [7

b) Explain convective heat transfer & Newtons law of cooling. [2016s] [2

c) A boiler is made up of iron plates 12mm thick. If the temperature of the outside surface be 120°c and that of the inner 100°c, Calculate the mass of water evaporated per hour. Assume that the area of heating surface is 5 m^2 and thermal coneductivity of iron is 84 W/mK. [5

[2016s] **Ans. 1115kg.** [7

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THERMAL ENGINEERING

Module - IV

1. a) **Define COP of regrigerator.** [2

b) The wall of a heat exchanger is mm thick, its material having thermal conductivity of 200 kJ / m / h / °C. The inner and outer surface co-efficients are respectively 50 kJ / m / h / °C and 80 kJ / m / h / °C. If the inner and outer temperatures are 120°C and 30°C respectively, determine

i) the overall heat transfer co-efficient

ii) heat transfer rate per sq. m of surface area

iii) temperature at the inner wall.

Ans : 30.67kJ/m²/h/°C, 2760.3 kJ/h, 64.79°C [5

c) A refrigerator working on reversed Carnot cycle works between the temperature limits of - 10°C and 40°C. Determine

i) C.O.P.

ii) E.P

iii) thermal efficiency of the heat engine if it works between the same temperature limits.

Ans : 5.26, ii) 6.26, iii) 15.97% [7

2. a) Define 'tonne of refrigeration' [2

b) What is reversed Carnot cycle ? Derive the expression for COP for refrigeration system. [5

c) In an air refrigerating machine working on Bell-Comeman cycle, the temperature at auction - 5°C, temperature at intel to the expander is 20oC. The air is compressed from 1 bar to 4.5 bar. Determine

i) the mass of air required to produce a refrigerating effect of 252000kJ/h

ii) the minimum power required to drive the plant and

iii) capacity of the plant in T. R. per kW

Ans : 3206.11kg/h, ii) 38.21 kW, iii) 0.5236 T. R. per Kw [7

3. a) State expression for COP of reversed carnot cycle. [2

b) Deduce a formula for C.O.P. of Bell-Coleman cycle in terms of pressure ratio. [5

c) Power required per ton of refrigeration in a Carnot cycle is 2 kW to maintain a temperature of - 30°C in the sink. Determine

i) C.O.P of the cycle

ii) temperature of the source

iii) heat rejected to the source per ton of refrigeration

iv) refrigerating effect per hour

Ans : 1.75, 108.86°C, 330kJ/min., 12600kJ

4. a) What is the function of refrigerator. [7

b) What is the concept of Refrigerator and heat pump ? Explain with diagram. [2015s] [2

c) Explain the working of a simple vapour compression refrigeration system. [2016s, 2015s] [5

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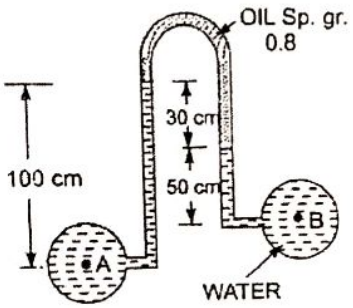
Module - I

a) Define fluid [2

b) Find the kinematic viscosity of an oil having density 981 kg/m³ . The shear stress at a point in oil is 0.2452 N/m² and velocity gradient at that point is 0.2m/sec. **Ans. 12.49 stokes** [5

c) In below Flg. shows in inverted differential manometer connected to two pipes A and B containing wter. The fluid in manometer is oil of sp. gr. 0.8. For the manometer readings shown in the figure, find the difference of pressure head between A and B. [7

Ans. $P_a - Pb = 2550.6 N/cm^2$, $H_{water} = 26m$.

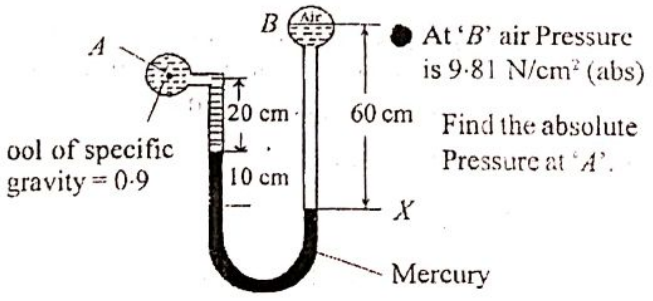


a) Define sp.gravity [2

b) The pressure intensity at apoint in a fluid is given 3.924 N/cm². Find the corresponding height of fluid when the fluid is : (a) water, and (b) oil of sp. gr. 0.9. **Ans. : h=4m., h=4.4m.** [5

c) A differential manometer is connected at two points A and B as Shown in Figure given below. [7

Ans. : $P_a = 8.887 N/cm^2$



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3. a) State Newton's law of viscosity [2

b) The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp.gravity 0.9 is flowing. The centre of pipe is 12cm below the level of mercury in the right limb. Find the pr.of fluid in the pipe if diff.of mercury in two limbs is 20cm.**Ans. : 2.597N/cm²** [5

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c) Determine the total pressure and depth of center of pressure on a plane rectangular surface of 1m wide and 3m deep when its upper edge is horizontal and

i) Coincide with water surface. **Ans. 44145N., 2m.**

ii) 2m below the free water surface. **Ans. 103005N, 3.821m.** [7

4. a) What is the difference between gauge pressure and absolute pressure? [2

b) With diagram explain meta center and meta centric height. [5

c) A stone weighing 490.5N in air and 196.2N in water. Determine the volume of stone and the specific gravity. **Ans. S=1.67, V=0.03m^3** [7

5. a) Define buoyancy. And Archimedes's principle. [2

b) Derive the expression for total pressure and center of pressure for a submerged vertical plate. [5

c) A Block of wood of specific gravity 0.7 floats in water. Determine the metacentric height of the block if its size is 2mt x 1mt x 0.8mt. **Ans. GM=0.028m.** [7

6. a) Define center of pressure and total pressure. [2

b) Determine the gauge and absolute pressure at a point which is 2.0m below the free surface of water. Take atmospheirc pressure as 10.1043 N/cm^2. **Ans. 1.96N/cm^2, 12.06N/cm^2** [5

c) A U-tube differential manometer connect two pr.pipes A&B.The pipe A contains a liquid having sp.gravity 1.4 under a pr. Of 100Kpa.The pipe B contains oil of sp.gravity 0.8 under a pr. Of 200 Kpa.The pipe Alies 2.5m above pipe B.Find the difference of pr.measured by Hg as fluid filling U-tube. **Ans. H_{hg}=53.12cm.** [7

7. a) What do you mean by metacenter? [2

b) Explain the working of Bourden Tube pressure gauge. [5

c) Determine the total pressure on a circular plate of dia 1.5 cm which is placed vertically in water in such a way that the center of plate is 2 m below the surface of water. Also find the position of center of pressure. **Ans. 3.467N, 2.0m.** [7

8. a) State expression for total pr.on a plane immersed in liquid. [2

b) Convert intensity of pressure of 20 kPa into equivalent pressure head of oil of specific gravity 0.9. **Ans. 22.65m.** [5

c) A simple manometer is used to measure the pressure of oil (sp.gr.=0.8) flowing in pipe line. Its right limb is open to the atmosphere and left lime is connected to the pipe. The centre of the pipe is 9cm below the level of mercury (sp.gr. 13.6) in the right limb. If the difference of mercury level in the two limbs is 15 cm, determine the absolute pressure of the oil in the pipe in N/cm^2. **P_{abs}=12.01N/cm^2** [7

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Module - II

a) Define steady flow and unsteady flow. [2

b) The diameters of a pipe at the sections 1 and 2 are 15 cm and 20 cm respectively. Find the discharge through the pipe if velocity of water at section 1 is 4m/s. Determine also the velocity at section 2. **Ans. Q-0.0704m³/s, V_2=2.24m.** [5

c) A horizontal venturimeter of size 0.65m x 0.35m is used to measure the flow of oil of specific gravity 0.85. The discharge of oil through venturimeter is 100 litre / sec. Find the reading of oil mercury differential monameter. Take C_d = 0.98. **Ans. X=0.35c.** [7

a) Define uniform and non uniform flow. [2

b) The diameters of a pipe at the sections 1 and 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if velocity of water at section 1 is 5m/s. Determine also the velocity at section 2. **Ans. Q=0.0392m³/s, V_2=2.23m/s** [5

c) Find the velocity of flow of an oil through a pipe, when the difference of mercury level in a differential U-tube manometer connected to the two tappings of the pitot-tube is 15 cm. Take sp. gr. of oil = 0.8 and co-efficient of pitot-tube as 0.98. **Ans. V=6.724m/s** [7

3. a) Define laminar and turbulent flow. [2

b) Water is flowing through a pipe having dia.300mm and 200mm at the bottom end and upper end respectively.The intensity of pr.at the bottom end is 24.525 N/cm2& pr.at the upper end is 9.81 N/ cm2.Determine the diff.in datum head if rate of flow through pipe is 40lit/sec. **Ans. Z_2-Z_1=14.934m.**[5

c) Water is flowing through a pipe having diameters 30 cm and 15 cm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 29.40 N/cm² and the pressure at the upper end is 14.715 N/cm². Determine the difference in datum head if the rate of flow through the pipe is 50 lt./sec. **Ans. Z_2-Z_1=14.614m.** [7

4. a) What is Pitot tube and state its function? [2

b) Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm2 (gauge) and with mean velocity of 2.0 m/s. Find the total head or total energy per unit weight of the water at a cross-section, which is 5m above the datum line. **Ans. T.H=35.20m.** [5

c) A venturimeter having diameter of 100 mm at the throat and 175 mm at the enlarged end is installed in a horizonatal piipeline of 175 mm in diameter carrying an oil of sp. gravity 0.95. The difference of pressure head is 180mm of Hg. Determine the discharge through the pipe, if C_4=0.97. **Ans. Q=0.05m³/s.** [7

5. a) Write the relation among Cd, Cv, & Cc. [2

b) A jet of water 50 mm dia moving with a velocity of 33m/s impinges on a flat plate moving with a velocity of 9m/s in the direction of the jet. Find the force exerted by the jet. **Ans. F_x1130.97N** [5

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c) A jet of water of diameter 50mm strikes a fixed plate in such a way that the angle between th plate and the jet is 30°. The force exerted in the direction of the jet is 1471.5 N. Determine th rate of flow of water. **Ans. Q=107.5 litre/s**

6. a) What is condition of maximum hydraulic efficiency when a jet strike on a series of flat blade mounted on rim of a cylinder ?

b) Derive the expression for the force of jet on a fixed plate.

c) A jet of water of dia.7.5cm strikes a curved plate at its centre with a velocity of 20m/sec.Th curved plate is moving with a velocity of 8m/sec in the direction of the jet.The jet is deflecte through an angle of 165.Assuming the plate smooth find:

(i) Force exerted on the plate in the direction of jet. **Ans. 1230.38N**

(ii) Power of the jet **Ans. 10Kw**

(iii) Efficiency of the jet **Ans. 56.4%**

7. a) State expression for impact of a jet an fixed vertical plate.

b) Draw velocity triangles for jet impinging tangentially in a moving curved vane state expressio for work done.

c) A jet of water 40mm diamater moving with a velocity of 120 m/sec impinging on a series vanes moving with a velocity of 5m/sec. Find the force exerted, work done and efficiency. **Ans. 17.34KN, 86.7KW, 8%**

8. a) State Bernoulli's theorem.

b) Define venturimeter and derive an expression for discharge through venturimeter.

c) State and prove Bernoulli's equation, write its assumptions and limitations.

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FLUID MECHANICS AND HYDRAULIC MACHINES (MET-404)

Module - III

a) State and write the Darcy's formula for the head lost in friction for flow through pipe with all notations [2

b) The discharge through a pipe is 200 liters/s. Find the loss of head when the pipe is suddenly enlarged from 150 mm to 300 mm diameter. **Ans. V=3.672m/s** [5

c) Water flows through old pipe 3.30m in diameter and 500m long at the rate of 0.2 cumecs. Take C=60, find the head lost in friction by using : i) Chezy's formula ii) Darcy's formula. [7
Ans. i) h_f=0.655m, ii) h_f = 0.20m

a) Explain Hydraulic gradient line. [2

b) Show that the loss of head due to sudden expansion in a pipeline is function of velocity head. [5

c) Find the diameter of a pipe of length 2000 m when the rate of flow of water through the pipe is 200 litres / s and the head lost due to friction is 4m. Take the value of C = 50 in Chezy's formulae. **Ans. d = 553mm** [7

3. a) Define turbine. [2

b) Describe the construction & working of a francis turbine ? [5

c) A pelton wheel has a mean bucket speed of 35m/s with a jet of water flowing at the rate of 1m³/s under a head of 270m. The buckets deflect the jet through an angle of 170°. Calculate the power delivered to the runner & the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. **Ans. : 2648700w, 99%** [7

4. a) Define impulse turbine [2

b) Draw the velocity triangle of single Bucket of a pelton wheel and find the expression for workdone / sec. [5

c) A pelton wheen turbine produces 20mw while running at 700 rpm. Under a effective head of 1700m. Calculate (i) least diameter at the jet (ii) mean diameter of Runner and (iii) Number of Buckets. **Ans. d = 103.17m, D=1037.1mm, Z=15** [7

5. a) Define hydraulic efficiency of a turbine. [2

b) Give a comparison between Reaction and impulse turbine [5

c) A Francis turbine with an over all efficiency of 75% is required to produce 148.25 kW power. It is working under a head of 7.62 M. the peripheral velocity = 0.26 $\sqrt{2gh}$ and the radial velocity of water at inlet is 0.96$\sqrt{2gh}$. The wheel runs at 150 rpm& the hydraulic losses in the turbine are 22% of the available energy. Assuming radial discharge, determine.

i) The guide blade angle, **Ans.: 32.619°**

ii) The wheel vane angle at inlet. **Ans.: 37.74°**

iii) Diameter of the wheel at inlet & **Ans.: 0.4047m**

iv) Width of the wheel at inlet **Ans.: 0.177 m** [7

6. a) Classify turbine in terms of head of water available. [2

b) Derive the condition of transmission of maximum hydraulic efficiency of an pelton turbine runner. [5

c) Draw the velocity triangle of single Bucket of a pelton wheel and find the expression for workdone / sec. [7

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FLUID MECHANICS AND HYDRAULIC MACHINES (MET-404)

Module - IV

1. a) Differentiate between single acting & double acting reciprocating pump. [2
   b) Describe construction & working of a centrifugal pump. [5
   c) A centrifugal pump delivers water against a head of 14.5 metres while running at 1000 rpm. The vanes are curved back at an angle of 30° with the periphery. The impeller diameter is 300 mm and outlet width is 50mm. If the manometric efficiency of the pump is 85%, find the discharge of the pump. **Ans. Q=0.237m³/s** [7

2. a) State expression for overall efficiency of a centrifugal pump.Explain slip. [2
   b) Write down the working of multistage pump. [5
   c) A double acting reciprocating pump, running at 50 rpm is discharging 900 litres of water per minute. The pump has a stroke of 400 mm. The diameter of piston is 250 mm. The delivery & suction heads are 25m & 4m respectively. Find the slip of the pump & power required to drive the pump. **Ans. Slip =0.017m³/s, P=0.775KW** [7

3. a) What do you mean by manometric efficiency of a centrifugal pump? [2
   b) Explain working of single acting reciprocating pump. [5
   c) A single-acting reciprocating pump, running at 50 r.p.m, delivers 0.01 m³/s of piston is 25cm and stroke length 50cm. then determine.
   (i) The theoretical discharge of the pump, (ii) Co-efficient of discharge, and (iii) Slip and the percentage slip of the pump. **Ans. i) Qthe = 0.02m³/s, ii) 0.50, iii) 0.01m³/s, 50%** [7

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